

NEWS IN PERSPECTIVE

MANAGEMENT VIEW

CONTINUE STRESSING R&D in A-power with actual plant construction carried out at a rate consistent with research achievements," EEI spokesman Elmer L. Lindseth, president of the Cleveland Electric Illuminating Co., urged JCAE. Mr. Lindseth reviewed progress which he called "substantial and adequate on the basis of all domestic considerations and . . . adequate to meet the requirements of friendly nations." He urged a continuing reduction in the Federal government's role in commercial nuclear power. He asserted that in a "truly free enterprise system" operating utilities, either individually or in groups, should construct, own, and operate all large-scale power reactors.

WE ARE BUYING SOCIALISM for ourselves, piece by piece; yet, Americans have stated repeatedly they want no part of socialism. This disturbing dilemma was emphasized in "The Vanishing American" address which won for CEI's Elmer L. Lindseth a George Washington Honor Medal Award last month. He warned in his talk: "Today, our various levels of government take more than 30-percent of the wealth we create . . . while competent economists say a free society is in trouble when 20 or 25-percent of its wealth goes to government in taxes." For other outstanding speeches, the Freedoms Foundation also honored PG&E's W-P Robt. R. Gros and EEI's Edwin Vennard.)

RETAINING OUR FREEDOM is no easy battle, warns West Penn Power's S. L. Drumm in another widely circulated speech. "The present drift to socialism is bound to continue unless the facts about our economic system are effectively presented to the people," he suggests. Mr. Drumm says we should learn the facts about American system, discuss the facts

with families and friends; be sure our school children are being taught these facts; expose employees to the facts through 'employee information programs'; and join in and support regional and national activities devoted to this cause.

Nth-DEGREE USE OF ELECTRICITY by utility company employees is urged by Commonwealth Edison's Chairman Willis Gale. "If we are to achieve greater sales, the first thing all of us must do is to believe in our product . . . and to believe in it is to use it. As we can, each of us should use electricity to the nth degree in our homes," he recommends.

WEST AND EAST OPPOSE the Burns Creek Dam in the Upper Snake River valley of Idaho, Congressional subcommittee hearings on the proposed \$50-million project have recorded. Opposition focuses on the fact that 98-percent of the cost involved in the authorizing bill (passed by the Senate last July) is for developing power facilities. Utah P&L's Naughton calls the project "unfeasible and unnecessary"; Montana Power's O'Connor criticizes dissipation of federal funds which could be used elsewhere in the reclamation program. And, from the East, Pennsylvania P&L's Busby and RG&E's Ginna added their voices in opposition.

ECONOMIC CLIMATE

BUSINESS IMPROVEMENT continues to show up in the future, as factory employment approaches its 1959 high and the number employed in service-related and distributive trades surpasses the 1959 mark. It seems clear, however, that while there are no immediate threats to prosperity, the tempo of demand has slowed. Buyers, confident of ample supplies, are not pressing for immediate delivery, preferring to let suppliers

NEWS IN PERSPECTIVE

shoulder as much of the inventory burden as possible.

INCOMES REMAIN HIGH, and they are rising slowly, except in the farm sector of the economy. This sustains consumer buying, though it is apparent that the ready availability of consumer credit is important. The rate of extension of consumer credit is very high; about \$14.50 in credit is made available for each \$100 in sales. Repayments are running at about 13% of disposable consumer income.

BRIGHT OUTLOOK for the rest of the year—confirming the President's predictions—is seen by the Congressional Joint Economic Committee, though its majority (by a split along party lines) thinks things should be better. Conceding that price hikes this year will probably amount to "not more than roughly one-percent of the increase in gross national product from 1959 to 1960," the group is nevertheless worried about the relatively

high rate of unemployment. The government, it says, should direct its policy toward achieving maximum use of production facilities, full employment, and "laying the basis for a higher rate of economic growth over the long run."

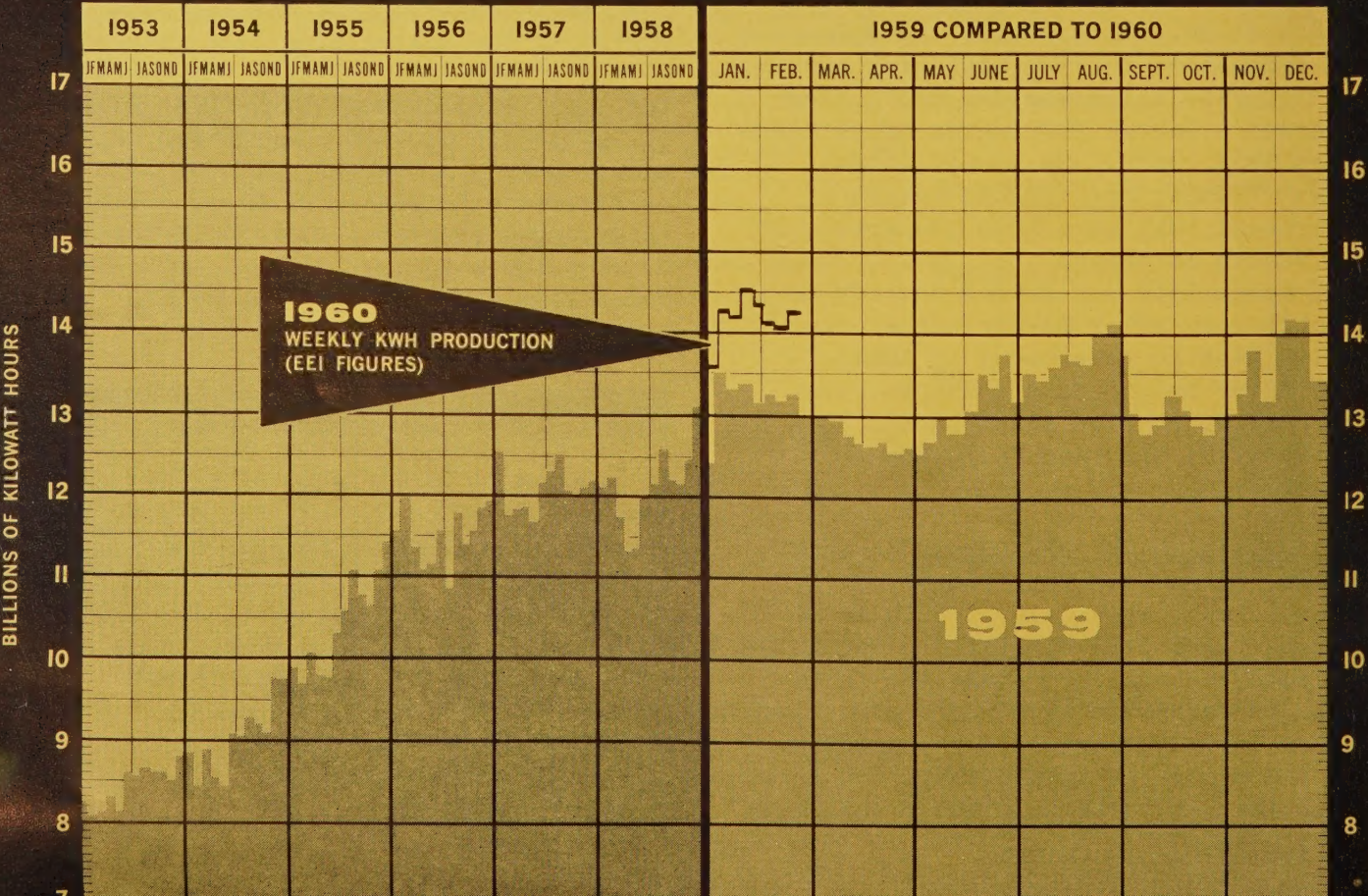
WASHINGTON INFLUENCE

RIGHTS-OF-WAY for power transmission lines should be "affirmatively" provided for in the Wilderness Bill, says Sen. Bennett (R., Utah), "in any case where the failure to grant them would unreasonably increase the cost of providing for transmission" of power. (EEI is holding a Right-of-Way Conference, Mar. 31-Apr. 1, at the Statler-Hilton, Cleveland. Engineering, economics, legal, safety and public relations are on agenda.)

REA INTEREST BILLS which would peg REA interest rates at the rate currently paid by the Treasury to borrow money have been introduced by Congressmen Edgar W. Hiestand, Charles M. Teague, and James B.

Electric Utility Barometer

(Source: Edison Electric Institute)



NEWS IN PERSPECTIVE

Ut of California. The bills also call for an administrative charge of .2-of-one-percent of the loan.

AEC CONSTRUCTION PERMIT actions include: (1) issuance of a provisional license to Carolinas-Virginia Nuclear Power Associates, which will have to provide additional technical data before final approval is given for the 17,000-kw pressure-tube reactor; and (2) scheduling of a hearing on March 29 concerning the license application of Consumers Power Co. for its proposed 75,000-kw unit.

ENTIRE COST OF A PROJECT should be appropriated at one time, Gen. Itschner, Chief of the Army Engineers, has told a Senate appropriations subcommittee. Construction would be speeded up, contractors would make lower bids, and the public would be aware of total cost. Itschner also indicated the Budget Bureau is interested in concentrating funds and deferring marginal projects.

NATIONWIDE RIVERFLOW FORECASTING is being considered by the Senate Select Committee on National Water Resources. Use of radar and high-speed digital computers would mean not only an improved system of flood warning but, according to Sen. Kerr (D., Okla.), "an unestimated though extensive further economic gain . . . from better operation of water supply, irrigation, hydroelectric, and other water-using projects." Weather Bureau's estimated cost is \$1-million annually.

WEATHER RESEARCH FUNDS, cut by the House, should be restored, says Sen. Wiley (R., Wis.). The House eliminated \$775,000 sought for tornado research, though it granted funds for hurricane research. In addition, the Army is testing a weather warning system that is claimed to instantly locate lightning discharges associated with severe storms over most of North America and report this data much faster than at present.

ATTACKS ON PRIVATE POWER were caused to be printed in the Congressional Record by Rep. Joe L. Evins (D., Tenn.). He placed two items in the Record whose titles alone make his position clear. One is called "Private Power Companies

Cashing in on Their Share of \$15-Billion Federal Subsidies From Rapid Amortization"; the other: "What Private Power Companies Are Doing with Their Federal Subsidies."

"ALL-ELECTRIC CONCEPT", theme of the general session of the EEI annual sales conference (Apr. 4-6 at the Edgewater Beach in Chicago) will be discussed from the viewpoint of the architect (R. W. Quinn, a Notre Dame student), the builder ("House & Home's" A. S. Goldman) and the manufacturer (GE's F. J. Borch). Detroit Edison's E. O. George reports a probable attendance exceeding 1000.

MAGIC "ONE-TO-ONE" sales ratio of gas to electric ranges is fast approaching, as the gap between sales of gas and electric ranges is rapidly closing. NEMA's Electric Range Section notes this in ballyhooing its "second big year of range promotion" and predicting 1960 shipments of 1,750,000 units. A gain from 2.06-to-one to 1.85-to-one was achieved for free-standing models last year; however, where electric ranges hold the lead—in built-ins—the industry slipped from a 2.35-to-one ratio in 1958 to a 2.08-to-one ratio last year. Warns NEMA: "This may well represent a trend which bears careful watching."

"LOOK" WIRING AWARDS this year go to three utility companies—Niagara Mohawk Power Co. and Virginia Elect. Power Co. (tied for 1st place among 250,000 meters-and-over companies); and Dayton P&L Co. (under 250,000 meters). Others honored: No. Central Electrical League (Minneapolis), R. C. Electric (Milwaukee contractor), and Noland Co. (Newport News, Va. distributor). Honorable mentions go to: Florida P&L, Kentucky Utilities Co. and Montana Power Co.

GEORGIA POWER'S WIRING PLAN (see EL&P, Feb. 1, p. 27) rolled up impressive figures in January—Jobs completed totalled 94 and jobs pending numbered 588, the utility reports.

LONG-TERM NUCLEAR OUTLOOK will require developing reactors other than the light water type that will soon be "salable to the utility industry on a competitive power basis," Dr. Chauncey Starr of Atomics International told the Joint Congressional Committee in recent 202 hear-

NEWS IN PERSPECTIVE

ings. Although he said the light water reactor was a "demonstration that a sound technical approach can be brought to a commercial position with sufficient support," he noted its size restriction. Dr. Starr felt certain of ample uranium resources and warned against saving uranium by over-emphasizing breeder reactors. Doing so "would alter the basis of our present national program by diminishing the near-term incentive for the development and construction of non-breeder atomic power plants and by leaving the long-term value of atomic power generally in doubt." (See page 63.)

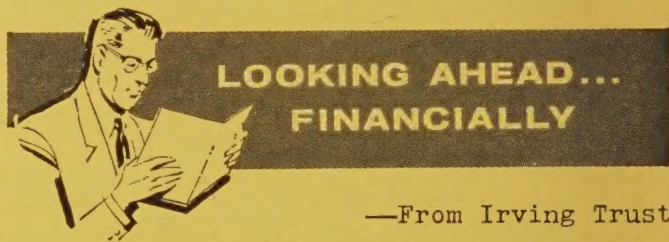
LABOR'S REACTION to AEC's ten-year A-power program is highly critical. AFL-CIO's Director of Legislation Biemuller called the program one of "no new starts until 1963" and urged drastic speeding up and firming. He advocated a new core for Shippingport to expand installed capacity to 150,000-kw. Speaking for the AFL-CIO, he called for a large-scale demonstration reactor program along the lines of the Gore-Holifield bills. A UAW spokesman complained of the high ratio of military appropriations when the atoms-for-peace program "seems to be on the verge of collapse."

RATE INCREASE PRESSURE is viewed with concern by New York Public Service Commission in its annual report to Gov. Rockefeller. For the first time in 20 years, the report notes, electric utilities have been overtaken by inflationary tide . . . "which in the last two years has outstripped all efforts to keep electric rates down."

PRESSURIZED PIPELINE UNDERGROUND will be used for the first time by the

United Illuminating Co. (Bridgeport, Conn.) to protect high voltage cable from corrosion. A six-in. diameter pipeline will stretch 2.5-miles between two bulk power supply points—part of a \$3.5-million expenditure for transmission extensions in 1960, the utility announces.

N. DAKOTA POWER SURVEY is being made by Burns & Roe for five utilities in the north central U. S. The study will estimate power production costs, describe plant features and water supply, and site investigation, electrical load analysis, system development and investment costs. Of special interest in this area: lignite as a potential fuel.



—From Irving Trust

New money financing in February of \$228,690,000 (60-percent electric), up slightly from January. Reception of the senior securities was poor.

Two AAA issues offered in Feb. (Duke Power, Consolidated Nat. Gas) sold slowly; as did three AA-rated issues (Duquesne Light, P. S. of Oklahoma, Dayton P&L); and the one A-rated issue (Texas Elect. Service) was poorly received.

Prices on seasoned company bonds and preferreds continued their climb, while prices on outstanding commons reversed their decline.

The only preferred offered in Feb. (Brooklyn Union Gas), a direct issue, was oversubscribed.

Commons marketed were all well received.

THE IRVING TRUST		January 31, 1960		February 29, 1960	
INDEXES SHOW:		% Yield to Maturity			
Bond Averages					
"Aaa"		4.72		4.65	
"Aa"		4.75		4.67	
"A"		4.89		4.85	
Stock Averages		Common—\$ Yield		Price/Earnings Ratio	
		1/31/60	2/29/60	1/31/60	2/29/60
Preferred—\$ Yield					
1/31/60		4.96	4.91	17.2	17.3
		5.08	5.05	16.9	17.0
		5.21	5.14	15.7	15.9
		4.32	4.27		
		3.53	4.51		
		4.40	4.40		

Joslin: How One Utility (C-E) Plans Long-Range

What are the most important factors affecting the long-range planning for electric power systems today?

Every system differs in some respect from others, of course, but key considerations enter into almost any utility's look ahead. Commonwealth Edison's Vice-President Murray Joslin reviewed most of the big ones in a recent ASME discussion, from which excerpts follow:

Although Commonwealth Edison has been using automatic equipment for years (such as the automatic dispatch system), Mr. Joslin said: "We don't propose complete automation of any of our presently authorized generating units. We are keenly interested in power plant automation and are following developments in this field closely, even though our initial steps may be limited to data logging and on-line computation of efficiency."

"This type of automation is not likely to be justified by manpower saving alone. Instead, it will enable the same or a slightly reduced operating force to run a safer and more efficient plant."

Mr. Joslin posed and answered the question: Why did we delay buying 500-megawatt generating units until now . . . or why don't we buy even bigger units now? In addition to technological reasons, he said, there is the question of how much capacity is needed in any year. Since a 500-megawatt unit will cost about \$25-million more than a 300-megawatt unit, the burden in extra fixed charges is substantial when 200 megawatts more is not immediately needed.

"Throughout the industry, studies indicate that for a large system such as ours the economical size of the largest unit may be from 7-percent to 8-percent of the total

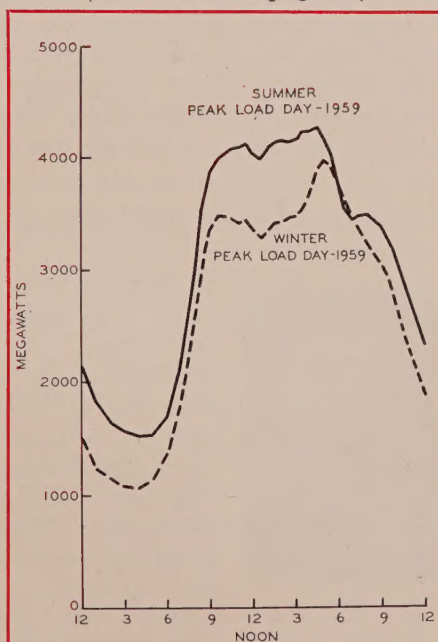
system capacity. After allowing for reserve requirements, this size corresponds roughly to one year's load growth. Both theory and practice show that it is best not to adopt a new size until the annual load growth is enough to require successive units of the same size for several years.

In Commonwealth Edison's long-range plans, reports Mr. Joslin, are these important considerations:

1. The possibility that some day it may be economical to install generating units just to carry peak loads.

2. The effect of nuclear power ("though CE is proceeding conservatively to plan on the basis of coal-fired plants").

3. Spectacular ideas for the direct production of electricity—fusion, (Continued on page 67)



HIGHER SUMMER USE of electricity became an overall pattern last year for the first time in the New York area served by ConEdison. Air-conditioning, now widely used, and other summertime load builders can change demand as much as one million kilowatts from one day to the next, reports ConEdison. Prediction for the utility's next summer peak: 4.4-million kw; winter peak (next Dec.): 4.1-million kw.

EEI Wraps Up

Report on Soviet Electric Power

As the Edison Electric Institute last month wrapped up its record-straightening presentation of how the U. S. stands vs. Soviet electric power (with release of EEI's 96-page study, "A Report on USSR Electric Power Developments, 1958-1959"), the forecasts of what we face in the future were most significant. As often as they have been reiterated in recent months, (See EL&P, May 1, 1959; Oct. 15, 1959) the assurances of informed industry spokesmen once more re-focused the view ahead . . . and the outlook remains a heartening one.

"Over-optimistic" goals . . . "spotty" growth . . . "the Soviet Union will not catch up"—these are expressions of reassurance that must be given considerable weight, since they are made by responsible industry leaders like Detroit Edison's Walker Cisler and Oklahoma G & E's Donald S. Kennedy. But, the most significant reassurance still comes from the emphasis on what the U. S. electric power industry will do.

In the New York presentation of EEI's report, here are some of the observations of the spokesmen:

SAID MR. CISLER—"The present seven-year plan seems to set up more reasonable targets for the Soviet economy. The goal for electric power production in 1965, including the amounts to be used within the electric stations themselves, has been announced as 500 to 520-billion kilowatt-hours. To reach this level of production, Soviet engineers estimate they will need to reach a capability of 110 to 112-million kilowatts.

"The present seven-year plan promises that attempts will be made to carry out the process of rural

electrification and to put greater emphasis on residential consumption, but it is difficult to see how the Russians can develop quickly the kind of consumer economy needed to bring down the industrial proportion of their electric use. While we have considerable evidence that they would like to, we also have considerable evidence that they are finding it difficult.

"For example, only last November the Communist Party Central Committee issued an appeal to almost every conceivable organization in the Soviet Union to save electric power. The same day, in a signed article in *Pravda*, I. T. Novikov, the Minister of Power Station Construction, complained that extension of transmission lines was being held up because of a shortage of wire. It seems fair to ask how electricity can be brought to farms if the material needed for transmission lines is unavailable.

"I do not want to leave the impression that in my opinion the Russians will not meet their goals for 1965 in electric power production. On the contrary, from everything our delegations learned in the Soviet Union, I am ready to assume that the goals will be met.

"Reaching the goals for 1965 will not be an easy task for the Russians, however. It is not going to be a matter of simply saying it will be done, and then having it done.

"The important thing to remember, it seems to me, is that Russian economic growth during recent years has been spotty. Rocketry has advanced rapidly. But agriculture has presented serious problems. Heavy machinery production has been emphasized, while consumer products have been largely ignored. What it comes down to is this: The Soviet planners have had to make a series of choices and in selected areas they have been highly successful. Where they have decreed growth, there has generally been growth. Sometimes the growth has not been in the quantity ordered, or of the best quality, but it has generally been accomplished. If the Russian planners are going to meet their goals for 1965 in electric power production, some area of the economy may be forced to suffer at the expense of others. When the final decisions are made, the second-class area may well continue to be the consumer sector of the economy."

SAID MR. KENNEDY: "The two economies are at different stages of development and, quite naturally, are growing in different ways. In any country electricity is produced to meet the demands for it. Although the use of electricity is an excellent index of economic growth and promotion of the use of electricity can contribute to that growth, increasing a nation's capa-

bility to produce electric power does not necessarily result in an increase in its Gross National Product. Building power capacity in excess of actual needs will not, of itself, increase the total production of an economic system. Indeed, this may be wasteful of capital and materials that might be better used in other segments of the economy.

"In the United States the electric utility companies work hard at selling electricity and promoting its use. At the same time, they are making constant studies of what consumption of electricity will be in the future. In this way the construction of electric power facilities in this country is tailored to the needs of commerce, industry, agriculture, and home consumption.

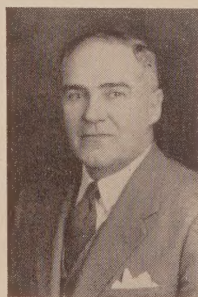
"On the basis of these studies, I would like to conclude with two forecasts which I have every confidence will be fulfilled. First, and most important, no matter what the Soviet accomplishments in the field of electric power production may be, no matter whether their goals are reached or not, the electric utility industry in this country will continue building the facilities needed to supply the American economy with an ample supply of electric power. The result will be, and this is my second forecast, that the Soviet Union will not catch up with us in the production of electricity in the foreseeable future."

McDonough: Utility Buyers Should Know Overall Plans

An appeal to public utility purchasing agents to know "not only the buying aspect of your business, but your company's over-all objectives and plans" was made recently by John J. McDonough, president, Georgia Power Company. Mr. McDonough made the statement in Atlanta as he addressed the 29th annual mid-winter conference of the Public Utility Buyers Group of the National Association of Purchasing Agents.

The Georgia Power Company president, addressing the group on "Public Relations," pointed out that a purchasing agent's knowledge of his company, plus a desire for fairness in all his business dealings, combines to form the two primary

requisites of a good public relations program.



J. J. McDonough

company's objectives. The company, in turn, has the similar responsibility of keeping its purchasing personnel posted on company activities and objectives.

"Working for a utility company," he told the group, "is unique as compared with other forms of employment in that the public eye is always upon us. Our books are wide

"The public utility purchasing agent," Mr. McDonough told the more than 400 persons attending the opening session of the conference, "has a definite responsibility to be familiar with his

open. As a consequence, the public's impression of a utility company is very much formed by the activities of the company's employees. What we do reflects either credit or lack of credit on the company.

"I am sure," Mr. McDonough added, "that each of you believes in your job and your company and that each of you has faith in the future of this great enterprise in which we are all engaged. Having these attributes, you have only to be reminded on occasions such as this that the public relations job of your company is centered in you, as a utility company employee."

Mr. McDonough took the occasion to laud the group for avoiding any "scandal" in the buying end of the utility business. He said he could not recall any in more than 35 years, "and not many industries have such a record."



Showdown Nears in Fight For Bridge Canyon

A long-delayed showdown is drawing closer in the contest between the State of Arizona and the City of Los Angeles over who shall develop the big Bridge Canyon hydroelectric project on the Colorado River.

After nearly three years of shadow-boxing, the contestants now have conflicting license applications to file with the Federal Power Commission. Being "mutually exclusive," the two applications will doubtless have to be heard in a consolidated proceeding. As the picture shapes up at present, Arizona is looking for action and wants an early FPC hearing. Los Angeles, not ready to put her chips down, is angling for an indefinite delay. The chances are that a hearing will be scheduled to begin early this summer.

Several developments in the background are worth noting. Chronologically, they run about like this:

The Arizona-Los Angeles fracas was touched off in July 1957 when the City and its Department of Water and Power applied to FPC for a preliminary permit for what was envisioned as a 750,000-kw project at the Bridge Canyon site, located just above Lake Mead. The Arizona Power Authority (APA), which had long been eyeing the site for future development, went into a series of actions which culminated a year later in an application to FPC for a license to build not only Bridge Canyon, but also an upstream Marble Canyon project.

The affair lagged on for another year while APA engineers continued to develop technical data to support the license application. Then last summer the Los Angeles people (on the basis of information that APA was about to press for

FPC action, according to an informed source) advised the FPC staff that the City would file a Bridge Canyon license application by January, 1960.

The next development was that Rep. Glenard Lipscomb, a Republican from Los Angeles, introduced last September a bill to authorize Interior Department to build and operate the Bridge Canyon project. The measure provides that the Federal Government shall pay the costs allocated to flood control, navigation, and recreation, fish and wild life benefits. State and local public power agencies would be given preference to participate in the power features as follows: agencies within Arizona, up to 30-percent; within California, up to 60-percent; and within Nevada, up to 10-percent. Falling water and utilization of generating facilities would be made available to such agencies in relation to construction costs advanced by them.

In November, APA revised its license application to include a third unit—a two-reservoir project on Little Colorado River to be built for silt detention. The revised plan calls for a total initial installation of 820,000-kw at Bridge Canyon and Marble Canyon, and an ultimate installation of 1,470,000-kw. Initial cost would be about \$347-million.

Then in December, the FPC staff held a joint meeting in Washington with the Arizona and Los Angeles people to discuss the matter of when the contestants could "get going" with their proposals. APA had earlier indicated it was ready to go, but at the time several staff members who would be involved in the proceeding were tied up with other cases. The Los Angeles representatives urged that no hearing be set on the matter before next fall.

The City's application, filed last

month, proposes a Bridge Canyon dam and power plant with installed capacity of one million-kw, and a single silt detention dam on the Little Colorado. Estimated cost of the project is \$243-million.

Los Angeles has come up with multiple reasons for wanting to delay action on the Bridge Canyon applications. It has contended that the case of *Arizona vs. California*, dating back to 1952 but still pending in the Supreme Court, should be cleared up first. That suit was brought by Arizona to establish a limit on California's right to divert Colorado River water. A final decision could possibly be rendered before the Court recesses in June; also it could well go over until next year.

Another contention of the City is that FPC should wait to see what Congress does with respect to the Lipscomb bill. Although purportedly offered as a compromise solution, the measure has the earmarks of a delaying gimmick. It has no chance for passage. The City also argues that it needs time to study Interior Department's recently completed operating criteria on Glen Canyon dam, the releases from which would affect the operation of the downstream Bridge Canyon project. Moreover, the Los Angeles people have stated, the City just can't be ready to go forward with its case before next fall.

None of these reasons is seen as carrying sufficient weight to move FPC to delay for long a hearing on a project of the magnitude of Bridge Canyon. A likely outcome is that the Commission will set a hearing to commence in May or June, and specify a procedure under which APA would proceed first. In any event, it promises to be a long, drawn-out affair, but one worth watching.



By A. C. Farmer
Economic Consultant

Tight Money, Price Inflation, and Business Activity

The increase in the index of consumer prices has been of great concern to the Federal Reserve Bank, who feel a special responsibility for controlling price inflation. To control price inflation it is necessary to slow up the expansion of money—purchasing power. For this purpose the Federal Reserve Bank has at its disposal several weapons, such as increasing reserve requirements of member banks, selling government securities from its portfolio, or increasing the discount rate on loans to commercial banks. Any or all of these methods result in reducing the rate of expansion of bank loans, which is the principal cause of monetary inflation.

In recent years the Federal Reserve Bank has been depending chiefly on an increase in the discount rate as a means of controlling the expansion of bank credit, which in turn operates to restrict price inflation. It will be noted from the chart that, disregarding oscillations, the discount rate has followed a trend line from one percent in 1947 to four percent in 1959. This increase in the discount rate has not prevented price inflation but has had the effect of slowing up the rate of increase of price inflation.

The principal effect of increasing the discount rate is to slow up the borrowing of money. This will be

noted by comparing the line representing bank loans at all commercial banks with the changes in the Federal Reserve discount rate.

As a result of an increase in the discount rate, bank loans leveled off in 1948-49, in 1953-54, and in 1957-58.

After each of these periods, however, bank loans again expanded at a fast rate (1) partly because borrowers became accustomed to higher interest rates and no longer regarded them as a serious problem, and (2) partly because in recent years, when business activity slowed up as a result of higher discount rates, the discount rates temporarily were reduced, as in 1954 and in 1957-58. When the pressure of the high discount rates was reduced, loans once more rapidly surged ahead.

Expanding bank loans provide an expanding volume of money, which means purchasing power, in the economy. On the other hand, whenever bank loans no longer are increasing, business activity immediately slows up.

It will be noted from the chart that the index of industrial production has made a dip whenever bank loans at the commercial banks have leveled off. Because of the leveling of bank loans, business activity slowed up in 1948-49, in 1953-54, and in 1957-58.

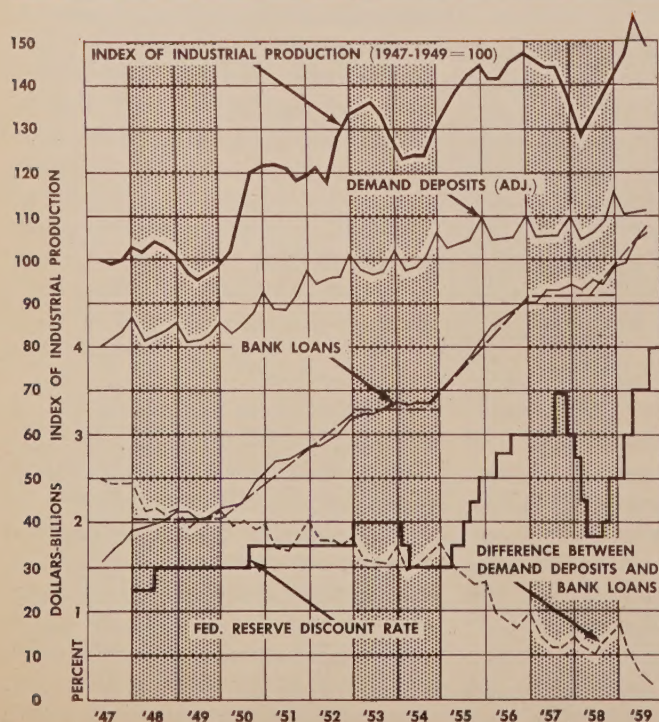
With this evidence it is possible to reach reasonable conclusions about probable business developments for the year 1960.

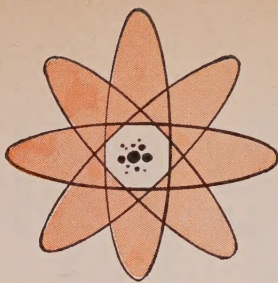
It will be noted that after bank loans leveled off in 1957-58, and the index of industrial production made a corresponding drop, the discount rate was reduced from $3\frac{1}{2}$ percent in the latter part of 1957 to $1\frac{3}{4}$ percent in the early part of 1958.

After this change, bank loans again started to expand and the index of industrial production again moved upward. As soon as this occurred, the Federal Reserve Discount Rate again was increased step by step, from $1\frac{3}{4}$ percent to its present rate of four percent (in some quarters an even higher rate for the Federal Reserve Discount Rate has been predicted).

A conclusion that can be drawn from developments in earlier years is that if the present Federal Reserve Discount Rate is maintained at a rate of four percent or higher, bank loans at the commercial banks again will level off in 1960. This in turn will cause another dip in the index of industrial production.

In an election year it can be assumed that there will not long be permitted, and that Congress will insist that the Federal Reserve Discount Rate once again will be reduced to maintain a high rate of business activity in 1960.





PURELY AN ECONOMIC BASIS can now be the consideration of utilities contemplating construction of large-scale nuclear plants, says AEC Chairman McCone. He told the Joint Committee in testimony last month that this view can now replace the "long-term development" approach that has characterized nuclear power planning heretofore. In his presentation he revealed that PG&E and So. California Edison are negotiating with GE and Westinghouse concerning new projects with 300-megawatt capacities. Though their estimated cost/kwh at the outset (8 mills) would be higher than the 7-mill/kwh cost for conventional plant power, "the plants would become competitive as conventional fuel costs rose and nuclear fuel costs come down," observed Mr. McCone.

CHANGES IN REACTOR LICENSING procedures are being proposed by AEC. Public comment is asked on three amendments that would apply to testing and research as well as power reactors. One proposal would clarify the amount of work that may be done on a project before the Commission issues a construction permit. Another would clarify the requirements necessary for issuance of construction permits and "would recognize that we are still in the developmental stage in reactor technology." The last would facilitate conversion of reactor construction permit to an operating license.

HAT BOILING WATER is the most promising approach for early attainment of economic nuclear power, as we believe, is a matter not for argument but for demonstration—GE's Francis K. McCune told the Joint Congressional Committee in the recent 202 hearings. He noted that GE has recommended that its work for the AEC should not be extended, while hoping for continuing support on the company's "promising work

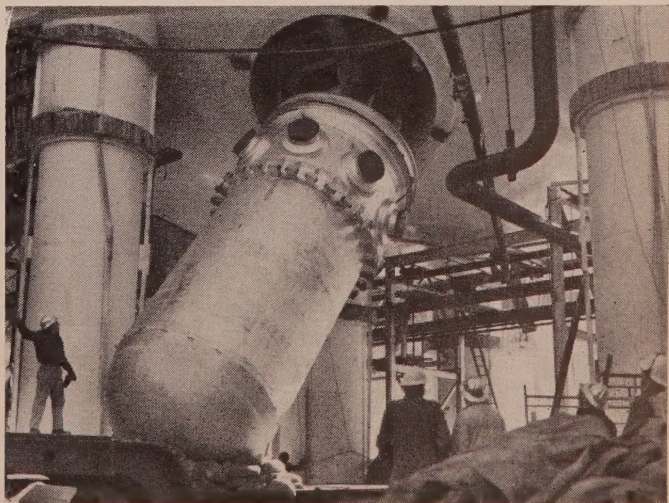
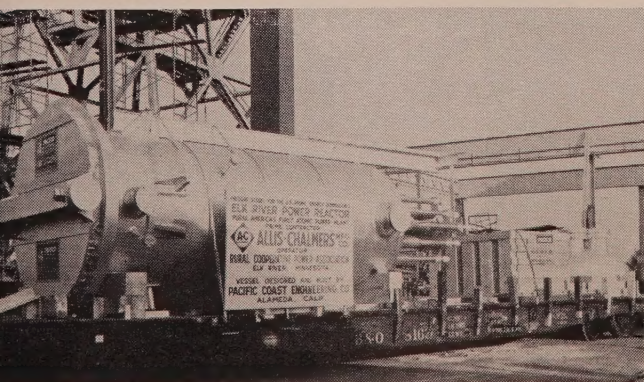
on fast oxide breeders." GE nuclear people also think well of the potential of the gas-cooled system, and of nuclear superheat; but "are not able to conclude that homogeneous reactors can be made economical."

DRESDEN'S FUEL LOADING, just about completed, has been accompanied by a series of low-level tests to establish data confirming the calculated reactor characteristics and operating procedures to be used with the full core. Soon now the reactor pressure vessel head is to be installed and the plant gradually brought to rated power. Minimum critical size for the Dresden reactor was established: 28 fuel assemblies; the temperature coefficient of reactivity became negative at 129-deg. F. (GE is interested in learning "how much the plant may be overdesigned for such things as stability, automatic shutdowns and environmental radiation levels, F. K. McCune noted in 202 hearings.)

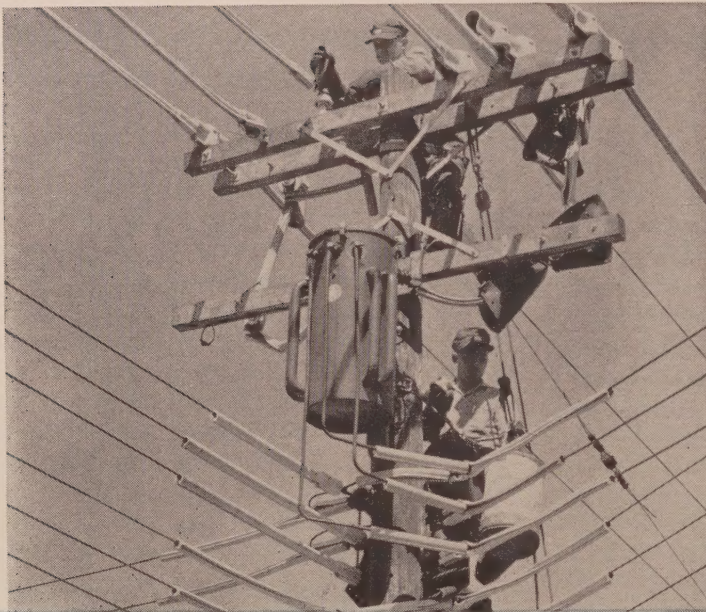
A MORE DECISIVE ROLE must be played by industry in the whole broad research and development effort, General Dynamic's Dr. Frederic de Hoffman told the Joint Congressional Committee in the 202 hearings. He said, "We have much to learn in many areas fundamental to the achievement of efficient and truly economic systems." And, another industrialist, Republic Aviation's V-P John J. Ryan, urged greater private industry participation in test reactor programs. (The Atomic Industrial Forum suggests in a special report that better two-way communication is the big need in government-industry planning of research and development.)

YOUTH CONFERENCE ON THE ATOM will be attended by over 600 persons as representatives or guests of the first 55 electric companies which had indicated to PIP (by Feb. 15) that they would participate.

NEW PRESSURE VESSELS ready to move along to sites are: (below) the 100-ft long, 7-ft diameter piece built by Pacific Coast Engineering Co. for the Rural Co-op Power Assoc., Elk River, Minn.; and (right) the 27-ft long, 13-ft dia. vessel built by Babcock & Wilcox for Yankee reactor.



The Pole Star Core



New Echelon Lap Means New Highs in Electrical Efficiency

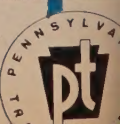
Example: 7200-volt line, average for all kva sizes

Characteristic	% Improvement over Previously Published Data
Total Loss	7%
Iron Loss	14%
Copper Loss	4%
Exciting Current	39%
Impedance	10%



As in the original time-proved Pole Star core, laminations are individually lapped as the core is built into the coil. Each lamination thus forms its own magnetic path, and no flux has to cross from one turn to the next.

**New design
retains basic
principles
proved in
thousands of
distribution
transformer
installations**



has a new **ECHELON LAP**

**RESULT: Lower Losses, Lower Exciting Current
Lower Impedance
Improved Regulation**

One of but four basic oriented-steel distribution transformer cores being used today, the Pole Star lap-on-top core provided new highs in electrical efficiency when introduced by Pennsylvania Transformer in 1947. So great was the improvement over previous standards that the patented Pole Star core has maintained its leadership for more than a decade without any major alteration in its design.

Now, Pennsylvania again takes a long step forward—by giving the Pole Star core a “new look” that reduces total losses as much as 9%, and exciting current as much as 46%. The lap (still located on top of the core) has been changed to an “echelon” pattern that results in a more compact, efficient structure with improved magnetic properties.

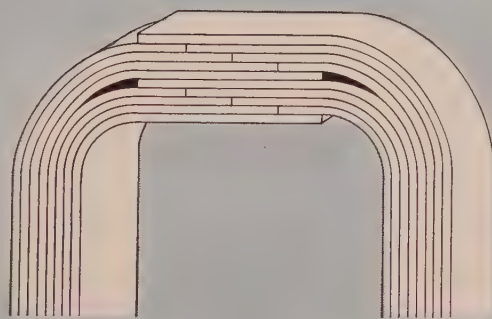
Laminations Are Individually Lapped

The basic principle of the time-tested Pole Star core has been retained—that is, laminations are individually lapped as they are built into the coil. Each lamination forms its own magnetic path, and no flux has to cross from one turn to the next.

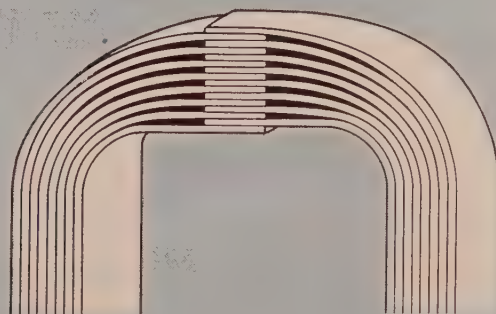
Along with major reductions in total losses and exciting current, the new echelon lap also provides improved regulation and lower impedance. For more information—or a quotation on your next distribution transformer needs—contact Pennsylvania Transformer Division, McGraw-Edison Company, Canonsburg, Pa.



NEW ECHELON LAP



ORIGINAL LAP-ON-TOP



Arrangement of the laps in an echelon design results in a more compact structure with improved magnetic properties. Laminations nest snugly together with no appreciable build-up of steel at the top of the core. The new design has been patented.

PENNSYLVANIA DISTRIBUTION TRANSFORMERS



Illinois Supreme Court Affirms Fair Value, Denies Normalized Taxes to Alton Water Co.

Illinois Court upholds Commission's and Company's use of observed depreciation.

A fair return of 5.6-percent on the fair value of the property can not be reduced because Company has high debt leverage.

Commission reversed in allowing Company to normalize taxes since in the Court's view liberalized depreciation results in a permanent reduction in taxes.

The background of the foregoing proceeding was the matter of increased rates which the Illinois Commerce Commission granted to the Alton Water Company. The last petition of the Company to the ICC proposed an increase in rates of 50-percent. This was granted by the ICC, whereupon the City of Alton took the case to the District Court of Madison County, which set it aside upon review. The Company and the Commission then took it on appeal to the Supreme Court.

Depreciation on Original Cost

In dealing with observed depreciation of the Company's property, the Company's witness testified that "... depreciation of 15-percent should be deducted from the reproduction cost of the company's plant." The Commission's witness testified to a depreciation of 26-percent, and the Commission found 25-percent as being the proper amount. The Supreme Court noted in part that: "The circuit court felt that the observation method employed by these two witnesses was not reliable since 40-percent of the Company's plant consists of pipes and mains located beneath the ground and not subject to inspection. Evidence of subnormal service to many customers, coupled with straight-line computations indicating a depreciation figure of 37-percent, convinced the court the Commission's determination was erroneous.

"Although the straight-line method of computing depreciation is widely accepted, it is only an accounting technique for allocating the cost of fixed assets over the life of the assets. It is not a measure of the actual deterioration of property. (*United Railway & Electric Co. of Baltimore v. West*, 280 U. S. 234, 262, 74 L. ed. 390 [1930]). For rate proceedings in which fair value is a controlling factor, a determination of depreciation by inspection may be preferable to accounting computations, and certainly is an acceptable method. (*See McCardle v. Indianapolis Water Co.* 272 U. S. 400, 71, L. ed. 316 [1926])."

The above citation of *United Railway v. West* is of considerable importance. The Supreme Court of the United States in that case in discussing the annual depreciation accrual, reversed the Maryland Commission which had based such accruals upon cost. The Court noted in part that: "The amount set aside periodically for this purpose* is the so called depreciation allowance. Manifestly, this allowance cannot be limited by the original cost, because if values have advanced, the allowance is not sufficient to maintain the level of efficiency. The utility 'is entitled to see that from earnings the value of the property in-

*The Court also noted significantly that: "It is the settled rule of this court that the rate base is present value, and it would be wholly illogical to adopt a different rule for depreciation."

vested is kept unimpaired, so that at the end of any given term of years the original investment remains as it was at the beginning.' *Knoxville v. Knoxville Water Co.* (1909) 212 U. S. 1, 13, 14, 53 L. ed. 371, 29 Sup. Ct. Rep. 148."

It would appear inferentially at least that the Illinois Supreme Court is opening the door for future Commission action to allow economic depreciation in the cost of service.

The Court's opinion also dealt with the question of the quality of the Water Company service. It said in part: "There was testimony that the Water Company's service to domestic customers and for municipal fire protection was deficient in many respects. This might well indicate that physical depreciation had in fact proceeded beyond the extent indicated by inspection. In holding the Commission's determination of depreciation erroneous, the circuit court considered this 'appraisal by function' as 'perhaps more convincing' than appraisal of depreciation by observation. The Commission on the other hand, dealt with the problem of substandard service not by adjusting depreciation but by a direct order requiring the Company to submit, in 60 days, plans for improving service.

"We cannot agree that the Commission's approach was erroneous. But supervision of service and supervision of rates are functions of regulatory commissions. In several jurisdictions, it has been held that these functions must be kept distinct so that a rate increase may not be conditioned upon the utility's compliance with an order to improve service."

Rate of Return

On the question of the rate of return, the Supreme Court upheld the Commission in its findings of a 5.6-percent rate of return on the fair value of the property, and

stated clearly that the mere incidence of high debt leverage in the utility which produces a substantial return on the equity portion of the capitalization is not a good reason to reduce the return granted above to a lower value. The Court's opinion noted in part: "The Commission found that a return of 5.6-percent was fair and reasonable. The lower court reversed this finding because its computations indicated that the common stockholder was in fact receiving a 17-percent return on its investment. This result was reached by subtracting interest on debt and preferred stock dividends from the estimated revenue after operating costs, \$230,758, to produce a net income available for distribution to stockholders of \$135,138. This amounts to approximately 17-percent of the common stock investment valued at par.

"The approach taken by the circuit court assumes correctly that the return to each class of security holder is relevant in judging whether a given overall rate of return is reasonable. Due to the relatively low cost of debt financing, an overall rate of return of 5.6-percent might yield a return to common stockholders of 6- or 7-percent in a utility with little debt but yield a much higher return to common stockholders of a highly leveraged utility with a high percentage of debt in its capital structure. Neither the Commission nor the courts may ignore this fact. *The circuit court also assumed, however, that return on the original common stock investment was the relevant figure in determining the reasonableness of an overall rate of return. In this assumption the court erred.** It is well established in Illinois that the utility is entitled to a reasonable overall return on the fair value of its property, not the original cost. This provides a flexible rate making standard which is equally applicable in periods of rising and falling price levels. (See *City of Chicago v. Illinois Commerce Com.* 4 Ill. 2d 54). It would be inconsistent to judge the overall return on the basis of fair value but judge the return accruing to common stockholders on the basis of a par value which is essentially original cost.

Italics supplied

Electric Light and Power, March 15, 1960

The significant figure is the rate² of return on common stock valued at fair value."

Treatment of Deferred Income Taxes

The Supreme Court sustained the lower court's findings that the Commission erred in normalizing the deferral arising from the use of accelerated depreciation. The Court's opinion said in part: "The Commission maintains that it is improper to allow present rate payers to receive the entire benefit under section 167 while subjecting future rate payers to an increased burden when the deferred taxes become due. It is not at all clear, however, that present customers will benefit at the expense of future rate payers. It appears that the depreciation deduction will be increased by accelerated depreciation for 17 years; only after that time could the tax burden increase. Whether it will actually do so, depends not only on the tax rates in effect at the time, but also the state of the Company's business, its operating expenses and gross income. (See *City of Pittsburgh v. Pennsylvania Public Utility Co.* 182 Pa. Super. 551, 575-76, 128 A.2d 372 [1956]). Furthermore, if the Company has expanded and added new facilities subject to accelerated depreciation, its actual tax liability may remain below that which would arise from straight-line depreciation. Thus, a continuous tax deferral might result from accelerated depreciation so that future rate payers would suffer no increased burden due to taxes deferred from the present. (See *In the Matter of Amere Gas Utilities Co.* [F. P. C. 1956] Docket No. G-6358 [Majority and Dissenting Opinions]; Note, 69 Harv. L. Rev. 1096, 1102 [1956]). The possibility of increased burdens in the future is too speculative to warrant imposing a definite and onerous burden on present rate payers."

What in effect the Court is saying is that there is a permanent forgiveness of taxes simply because of the prospective growth of the utility. An illustration of this fallacy can be seen in the accrued tax liability of the Class A and B utilities of the United States in 1948 and 1958, when such amounts were \$575-million and \$1,109-million respectively. By this kind of an argument one

would say that the original \$575-million which has nearly doubled by 1958, has never been repaid. This, as everyone knows, is simply not true.

In dealing with the problem of liberalized depreciation, a recent Order of the Montana Commission with respect to the Mountain States Telephone Company is of interest. It says in part: "We note that opinions differ on this subject, and until more conclusive proof is produced that an actual tax saving is realized, we are constrained to consider the utilization of such a depreciation method as merely a tax deferral."

The Commission has appealed to the Court for a rehearing.

COMMONWEALTH EDISON—

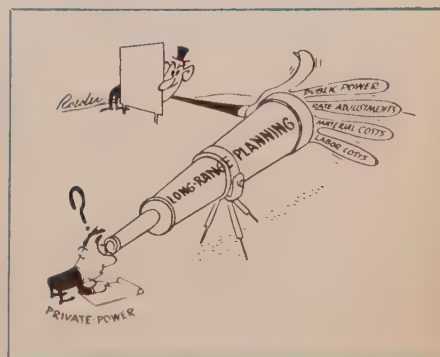
(Continued from page 57)

magnetohydrodynamic, thermionic, thermoelectric, fuel cell.

Of the latter, he said: "While these new devices may ultimately find their place, this will not occur over night. We expect to have ample time to evaluate each step in their development and, by planned action, I believe we can use them to our advantage."

Mr. Joslin noted that his company must also consider in its planning the fact that CE is part of an interconnection of power systems covering all or parts of 30 states. Among 100 companies with a total interconnected capacity of over 60-million kilowatts, CE has direct ties with six other companies.

"Our interconnections have been very important, both at times of system trouble and in day-to-day operation," observed the CE executive. "And, there is one feature of the interconnections we can easily evaluate in terms of dollars—the purchase and sale of economy energy. Since mid-1958, the aggregate amount saved by Commonwealth Edison has been \$450,000."



A-C Surrenders Two Oil-Testing Patents

Allis-Chalmers has surrendered patent rights to two methods for testing transformer oil which it developed in its Central Research Laboratories. One method is for estimating interfacial tension of the oil; the other for estimating the neutralization number of an oil.

The inventions, which are being applied in A-C kits for quick testing of transformer oil without requiring highly technical personnel and expensive equipment, will be published by ASTM and AIEE in their standards books.

Installed KVAR/Peak Load KW Stabilize

The ratio of installed capacitor kvars to peak load kw in the United States remained unchanged at 0.40 during 1959. According to W. G. Hart, manager of power capacitor sales, General Electric Co., the identical 0.40 ratio of installed kvar to peak kw for 1958 and 1959 indicates that capacitor usage during that period merely kept even with the increase in peak load kw. However, the historic trend to higher ratios is expected to resume in 1960.

Because of price, weight and size savings in capacitors, Mr. Hart says a considerably higher kvar to kw ratio can be justified. He estimates that one kvar installed for each two peak kw is the justified average ratio for the electric utility industry. He bases his estimate on the relationship of today's capacitor prices to the cost of alternate sources of kvars.

More Industry Record Breakers

A 400-mva two-winding transformer has been ordered from General Electric Co. by Public Service Electric and Gas. The 230-kv step-up unit will be installed at the company's Sewaren generating station in July, 1961.

Meanwhile, General Electric has shipped a 208-mva, 417-ton transformer with a sound-absorbing aphonetic enclosure to Consolidated Edison's Hudson Ave. station. It will be used for phase-angle regulation. The transformer achieves a sound level 23 db below units with a similar rating by using a hood lined with sound-muffling fibre-glass batts.

The first vapor-cooled substation transformer with gas-filled load-tap-changer was shipped to Gulf States Utilities from Westinghouse Electric Corp. It is rated 7500/9375 kva, 67 to 13.8 kv, three-phase.

Arkansas Power & Light is having a 384-mva, 3600-rpm turbine-generator built by Westinghouse. The

unit will be capable of ten percent additional capacity when the hydrogen inner-cooling gas pressure is increased from the normal 45 psi to 60 psi. The complete unit will weigh about 500 tons and will be about 42 ft long. Delivery is scheduled for the first half of this year.

Ninety-Eight-Percent Fly Ash Removal

When Brayton Point Station of New England Power Service is completed in 1962 at Somerset, Mass., its precipitator will be called on to remove 98 percent of fly ash, from the waste gases of a boiler producing 1,675,000 lbs of steam per hour and using pulverized coal as fuel.

The precipitator, by Koppers Co., will consist of two chambers, each with three separately energized precipitation fields, housed in a common shell approximately 102-ft wide, 31-ft high, and 27-ft deep. Gas flow through the precipitator will be about 716,000 cfm.

Portable Breaker-Testers for Yankee

Yankee Atomic Electric will use a five-kva portable testing unit for checking feeder circuit breakers prior to installation at the Rowe, Mass. plant site. The air circuit breakers to be tested are low-voltage, 25,000-amp-interrupting capacity class for the plant's feeder circuits. Primary purpose of the pre-operation testing is to have the breaker trip coils set at points suitable for the respective feeder lines. The breakers will be tested for minimum trip (85-400 amps) and instantaneous and short-time tripping (800-400 amps).

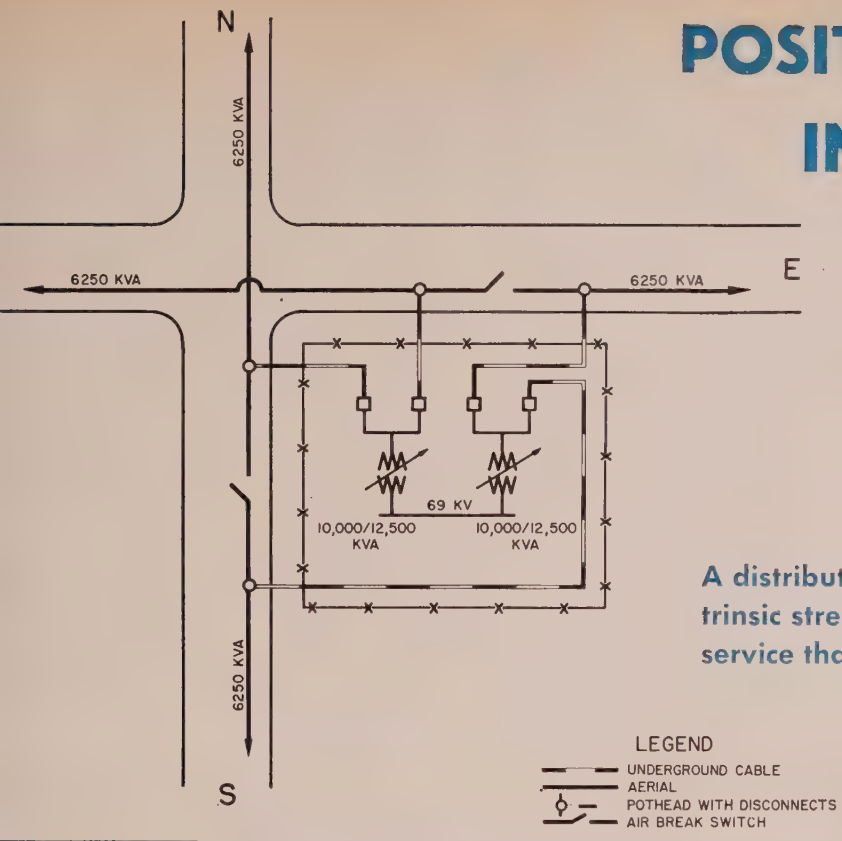
The unit, a Multi-Amp Model 4050/48/62, is the first of its type to be used for this class of service in a nuclear electric generating plant.

Rigid Vinyl Pipe Fights U. G. Corrosion

Rigid Geon vinyl pipe is being used to solve underground corrosion problems at the Sanford Station of Florida Power & Light, southeast of Daytona Beach. Geon vinyl, a B. F. Goodrich Chemical Co. product, was used because of its high strength and resistance to salt water, gases and corrosive soil conditions. The conduit's smooth inner surface will allow future cable pulling with the same ease as a new installation. A contractor who installs the conduit for Florida Power & Light reports that labor costs to install vinyl are 70-percent less than for installing conventional metal conduit.

POSITIVE PLANNING IN DISTRIBUTION

By CHARLES E. FLAHIE
Chief Electrical Engineer
The Toledo Edison Company



A distribution system should be built with an intrinsic strength toward quality and continuity of service that inhibits failure.

Illustrating simplicity in substation construction is this layout for two transformers with accompanying switchgear.

QUALITY of service can be excellent in any utility system. But too many engineers think of improved service in terms of a minimum system so weak that it must be propped up by emergency measures such as by multiplying breakers, switches, and transfer schemes. Such a philosophy might be called one of negative dependence. Service failure is its point of departure. These systems burgeon with sectionalizers, restorers, and throwers of all kinds.

I believe that distribution engineers, as a class, are apt to be tender-minded rationalists, defending practices deductively. Spare facilities and questionable practices such as too many protective devices and inadequate voltage levels are defended on theoretical grounds after the evidence is in.

Fear seems to be an occupational malady. Factors of safety are then compounded and money goes down the drain. But it is impossible to design all risks out of a distribution system.

Far healthier is the positive determination to build into a system

an intrinsic strength toward quality and continuity of service that inhibits failure.

Design Feeders Positively

First principle in design of any feeder is prevention at all times of lockout of the feeder breaker. In other words, permanent faults such as caused by falling trees, crane booms, or broken conductors must be prevented or isolated to preserve the feeder itself. This seems so fundamental as hardly to deserve mentioning but many times it is overlooked.

This concept of an inviolable or strong section for every feeder leads directly to necessity of choosing what section will be strong.

A route must be selected for this strong or main-trunk section that will be free from dangers of overhanging trees or other accidents. Not all streets, alleys, or rights-of-way are equally hazardous and frequently a route can be found that is less accident-prone than others. Adequate trimming and other safeguards can help build up strength in this section.

The small, weak, portions of a feeder can then be separated into

branches off the trunk and so arranged that they can isolate themselves when in trouble. The primary fuse is cheap and dependable for this purpose. Most permanent faults occur on or can be confined to these subsidiary branches. Only ordinary materials and techniques are required for this service as has been proved in experience.

Once branch fusing is adopted, tree trimming can be done selectively. Much greater risk is warranted if consequences can be confined to only a few customers. However, by the same logic, the main trunk must be kept assiduously clean.

Feeder breakers must trip only for unrelieved short-circuits. Line fuses and breaker relays must coordinate with a safe margin but highest ratings of fuses possible should be used to keep blowings to a minimum. It is easy to use too many branch fuses through fear of hypothetical consequences.

Devices designed to save equipment from tolerable overloads by interrupting customers should be used with care. A real need should exist if devices like reclosers and sectionalizers must be depended

Editor's Note—This is the essential text of a paper presented by the author before a recent meeting of the American Power Conference.

upon in lieu of more rugged construction.

Conductors large enough for main-trunk capacity will generally provide their own mechanical strength adequate for safety. Structures a little stronger than usual and lightning and insulation strength a little greater than minimum requirements provide extra electrical and mechanical assurances.

Mechanical strength of conductors is only one of the problems in determining their size. Kelvin's law states that size of a conductor is most economical when annual cost of electrical losses over its length is just equal to annual cost of investment for that length of conductor. This is excellent as a rough measure of proper conductor size for transmission circuits but becomes most difficult to apply on distribution circuits.

A home-grown rule for distribution circuits that has proved surprisingly effective and helpful is—greatest economy of conductor size with a growing load on a distribution circuit is achieved when thermal limit at the head end and voltage drop limit at the tail end are reached together. This determines maximum conductor size.

Minimum size in the main trunk is commonly set by capacity required by ties to an adjacent substation. Minimum size for branches is set by mechanical strength required to stay up in all kinds of weather. Economics is not the main consideration here. Mechanical strength added by larger conductor sizes is not too expensive and extra electrical capacity gained thereby will soon be used up by increasing loads.

Studies indicate that the same is also true in secondary conductor sizes. The larger size is generally preferable at not much increase in cost. Reduced losses, better voltage, and growing loads will generally justify practically any secondary conductor size installed from No. 2 to 2/0.

Voltage Control

Concepts of transmission and distribution must be distinguished clearly in all matters having to do with voltage. Transmission at distribution voltage such as to feeder load centers remote from distribu-

tion substations is apt to be wasteful. On the other hand, voltages suitable for transmission have a high cost for insulation when used for distribution.

Transmission is linear and has only one dimension, length, with power being carried as in a package from one point to another. But distribution has two dimensions and has to do with dispersal over an area. It is measured by such units as kva per sq mile while transmission lines are rated by capability in kva. Techniques and equipment for the two functions should be considerably different.

Now, a feeder that transports all its load from a substation some distance to a load center before beginning to distribute is doing a transmission job, pure and simple, at low voltage.

On the other hand, with bus regulation, the feeder can function for the first customer beyond the fence. Since there are no distribution conductors doubling back along the feeder, bus regulation makes one feeder per pole possible. If more than one distribution feeder is found on a pole, only one is distributing and the others are transmitting.

Planning For The Future

It is difficult to separate new ideas from old in a philosophy for planning but perhaps a quick review will, by emphasis and content, point out desirable procedures.

Voltage

Historical evidence is conclusive that we must postulate continuing load growth. Consequence of load growth is requirement for higher voltages, which means higher voltage for every component—utilization, primary, subtransmission, and up.

The first thing a planner must do is to straighten out his voltage levels. No pole can be replaced, no line can be rebuilt, no transformer can be replaced with economics clear until tomorrow's voltages are decided upon.

A planner can come up with some surprising conclusions if he tries to reach too far into the future. Planning for a system for more than treble the present load could result in voltages and capacities and equipment that could become obsolete before the expected load was realized, not to mention excessive carrying charges on a system so heavily overbuilt.

This metal-clad, 20,000-kva substation unit supplies three primary feeders and has provisions for additional equipment later.



Suppose, for example, that considerably increased load is expected on the system in the next 10 to 12 years. A decision must be made as to what distribution voltage will best serve this load. There are two possible routes, superposition and conversion, to follow in adapting a system for increased load. Both have to do with voltage considerations.

Superposition

It is electrically possible to retain the present distribution voltage forever more if desired. Thus, if a 4.16-kv feeder becomes inadequate, sub-transmission can be extended to its mid-point and a new substation installed. This process could be continued with more and more overlay of subtransmission, and with 4.16-kv feeders increasing in number and decreasing in length indefinitely.

Every foot of 4.16-kv distribution remains when this plan is adopted despite historical evidence that economy forces all voltage levels upward. But miles of subtransmission and number of small substations increase proportionally to the load as the function of distribution is given over more and more to transmission. Subtransmission and substations are expensive and require a lot of real estate. Subtransmission grows in complexity with more alternate feeds and more breakers and becomes more difficult to operate. Somewhere along the line comes a point where increased costs and difficulties overbalance objections against a higher distribution voltage.

Conversion

The other process is conversion of existing primaries to a higher voltage. Load-carrying ability goes up and voltage regulation improves, both as the square of the voltage, if conductors are made adequate.

But there are disadvantages as well. Equipment with years of life yet remaining must be replaced. Labor costs in conversion are high. Service reliability suffers for a time as backup feeders become unavailable due to different voltage levels.

Planning voltage conversion as a day-by-day process rather than as a single act to be executed and completed will produce a practical order of buying, building, and re-

placing that will gradually raise the voltage level.

Certain practices have been found desirable on Toledo Edison lines during a period of conversion. These may or may not be as effective on other systems.

Present practice is a process of conversion to a uniform primary distribution voltage for the entire system. Economic analysis may point to advantages of a higher voltage for rural than for urban distribution. But family farms become pork and egg factories, rural becomes suburban and suburban becomes urban. In this dynamic process, borders between voltage areas shift, conversion between voltages takes place without much plan, field ties between areas become impossible, dual stocks of transformers are required, and operation of the system becomes increasingly difficult.

Existing substations are being converted gradually to the new distribution voltage so as to use as much life of existing equipment as possible. Beginning with one transformer and with as little as one breaker, load growth each year is picked up on the higher voltage. No special difficulties have been experienced because of added hazard caused by increasing load and service responsibility on single feeders.

Eventually lower-voltage facilities will be worn out and gone while a higher-voltage system with two or three times the capacity will have painlessly taken its place. Only the low-side equipment is replaced, leaving all other facilities to serve out their useful life.

No attempt is being made in Toledo to extend the original lower-voltage system. Every pole, every dollar, every manhour is being directed to preparing the system for the higher voltage, no matter when actual conversion may be made. This requires some sacrifices, for when do porcelain insulators bought for a lower voltage wear out? Or how long does one anchor himself to low-voltage distribution transformers just because there is still remaining life in them?

We feel that the practice of selecting a fast-growing area for conversion and moving released equipment to a reservoir lower-voltage area has some drawbacks. Economics

can play strange tricks when moving fully-loaded equipment from one location to another. Problems develop all over a system, which can be just as acute in a slow-growing area as anywhere else.

In every case we have tried to select areas for conversion that required major attention. Low voltage at the end of a feeder (after the usual crutches have been added) could be such a trigger. Other indicators could be where substation capacity had been exceeded or where a feeder should be rebuilt because of physical conditions.

Conversions have been made only as problems appeared. Thus, feeders with voltage trouble have been shortened gradually toward their sources, keeping them fully loaded, while their far ends have been converted to the higher voltage. When substation capacity is exceeded, an added substation transformer with new feeders at the higher voltage close to the substation begin to relieve the situation. Voltage sag at far ends of feeders between substations has been cured by converting one feeder to the new voltage and cutting over load from the second feeder.

Handling of stocks of distribution transformers has provided a very sensitive control of speed of conversion. Lower-voltage transformers released by conversion can just meet spot needs for transformers on the remaining lower-voltage system if speed of conversion is correct.

All new transformers can be purchased for the higher voltage if capacity purchased just equals requirements for load growth plus capacity retired for poor conditions and obsolescence. This method makes every transformer serve out its useful life somewhere.

The same benefits will be found by following a similar program in purchasing substation equipment.

Substations

Finally, the substation is an integral part of the distribution system. Distribution economy depends on its location, size, and complexity. Every effort should be made to develop existing substations when converting to a new voltage. New substation locations and sizes should always result from natural requirements of voltage or load and never should be selected arbitrarily.



Transformer is loaded on huge multi-wheel low-bed tractor-trailer rig at railroad siding of local lumber yard where it could park parallel.



Enroute to substation, utility lines had to be lifted over transformer at some locations by PEPCo and Telephone Company line crews.



Cribbing tractor-trailer to place it at foundation level.

How PEPCo Moved Its Largest Transformer

By ROBERT E. SCOTT

Acting Superintendent

Substation Construction Division

Substation Department

Potomac Electric Power Company

Careful planning, scheduling and timing by utility and manufacturer contributed to a safe and smooth moving operation from rail siding to substation site.

POTOMAC ELECTRIC Power Company recently received its largest transformer requiring transportation over city streets from rail siding to substation site. Although exceeded in capacity by a 217,000-kva generating step-up transformer handled with the station crane at the Company's Dickerson Power Plant, Dickerson, Md., the 150,000-kva tap changing under load unit is the first of two such transformers for stepping down the 230-kv line from Dickerson to supply the Takoma 69-kv bus.

PEPCo. was notified when the transformer left the manufacturing plant at Cannonsburg, Pa. A factory representative rode in the train caboose to protect against humping and to assure prompt delivery. Daily reports were received regarding the progress toward the rail siding in Takoma Park, D. C.

Trailer Rig

Details concerning the route from rail siding to transformer foundation in Takoma Substation, a distance of $\frac{3}{4}$ mile, were planned by PEPCo., together with personnel of a local heavy equipment mover. The immense size of this transformer 11 ft 5 in. wide by 14 ft 11 in. high and 33 ft 6 in. long were in excess of the capacity of any local equipment. In order to keep axle and tire loadings in conformance with local street and highway regulations, it was necessary to bring

a huge multi-wheel low-bed trailer rig from Philadelphia.

As the transformer neared its destination, the moving plans were placed in operation. The huge 52-wheel tractor low-bed trailer unit was scheduled to arrive in Washington simultaneously with the transformer.

Special Cribbing

The transformer car was switched to the siding of a local lumber yard where the tractor trailer could park parallel. The space between car and trailer was cribbed with large timbers so that the transformer could be moved onto the trailer with solid bar rollers. This operation required one day.

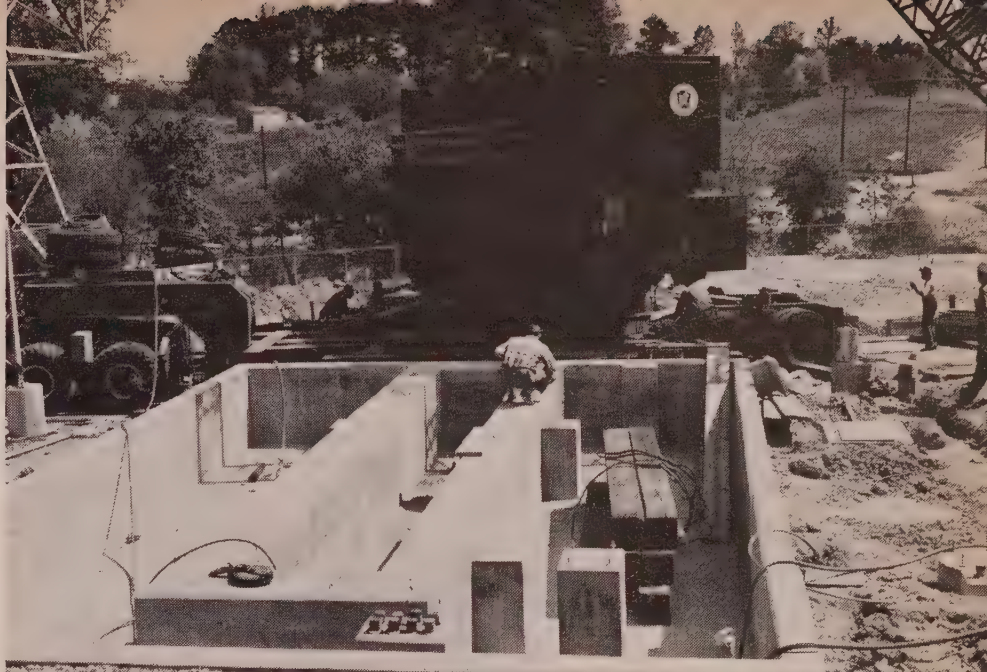
The following morning at 4:30 a.m., a light traffic period, the tractor trailer started for the Takoma Substation. PEPCo. and Telephone Co. crews raised all interfering wires along the route to permit continuous progress to the substation site. Here special cribbing again provided the path for rolling the transformer onto the foundation. It is interesting to note that the transformer was turned through 90 degrees during this latter operation in order to correctly orient the transformer on its foundation.

These movements, from railroad car to transformer foundation, were completed in two calendar days. The total charges by the movers amounted to approximately \$14,000.

Foundation

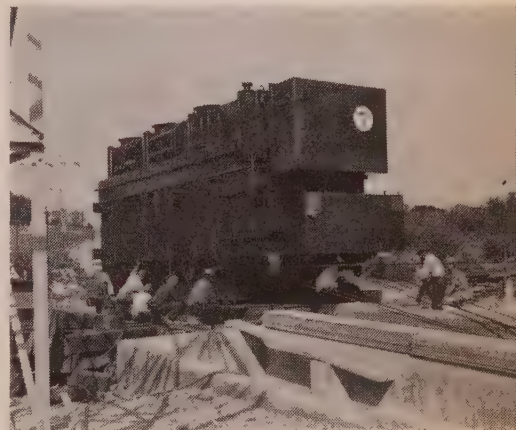
The transformer foundation consists of a concrete pit bisected with two concrete beams to support the transformer. This gravel filled pit was a volume which will contain one 14,000 gal of oil required to insulate and cool the transformer. Should a ruptured tank result in an oil fire, the gravel will absorb heat and permit the oil to quickly percolate to the bottom of the pit and drain off to a reclaiming sump where it can be salvaged. The gravel also provides a service area around the base of the transformer.

This tap changing transformer has a high voltage rating of 220,000 GrdY/127,000 volts, with LTC equipment that provides 32 full-capacity tap positions over a plus or minus range of 10 per cent. Tertiary voltage is 13,800 delta volts.



Transformer and trailer arrived at right angles to transformer foundation. Here transformer is shown being turned on trailer.

The 230-kv feeders which supply this transformer also supply a 100,000-kva, 230/33-kv transformer. Two 45,000-kva, 33/69-kv transformers tie the 33-kv and 69-kv busses. A 69-kv, 90 MVA pipe cable provides additional capacity from the Company's other plants. These sources back up the subject transformer at this time. A future 150,000-kva, 230/69-kv transformer will insure firm service for the ultimate arrangement of the 69-kv bus at this station.



Transformer is ready to move from trailer to concrete foundation.

Transformer is in place on its concrete foundation. Pit is to be filled with stones.



IMPROVED SPECIFICATIONS . . .

ENGINEERING SPECIFICATIONS — HOW MUCH CAN THEY BE "IMPROVED"?

Authors of the accompanying article discuss an area of buyer-supplier relations which, all too often, is given less attention than it merits. Without question, more carefully prepared specifications can—as the authors observe—"protect the buyer . . . and realize for their companies or clients all possible cost savings and equipment reliability." Moreover, as is also noted, more adequate specifications not only protect the buyer, but are welcomed by most of the reputable suppliers.

How much can engineering specifications be improved? *ELECTRIC LIGHT AND POWER* would like to find out . . .

Can you, like the authors, offer examples of "improved" specifications? If so, won't you send us your "before-and-after" versions of such specifications?

Provisions you make for buyer protection, terminology used, detail identified, etc.—all could be of interest and helpful to others. So, to the extent possible, *EL&P* contemplates reproduction of the most outstanding examples (with permission . . . and with or without identification) either in *EL&P* or as a publication separate service for the industry. Simply address your example(s) to The Editor, *EL&P*, 6 North Michigan Avenue, Chicago 2, Illinois.

HERE'S "WHY" and "HOW"

By FRED A. ALLEHOFF, E.E.,
Reg. Prof. Engineer,
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THE ENGINEER'S most significant contribution to the majority of contracts with which he deals is in the area of technical specifications, which usually form the heart of the more important contracts. Technical specifications are almost universally used not only for construction contracts, but also in the procurement of raw materials, in the establishment of manufacturing procedures for the utilization of these materials, and in sales literature defining the finished product. In addition, in many fields the most substantial portion of the product is manufactured to meet customer specifications.

The engineer, therefore, cannot detach himself from knowledge of specifications, their interpretation and their technical and legal impact. An examination of the many activities being initiated and defined by technical specifications clearly reveals that specifications are the engineer's formal mode of communication with businessmen, contractors, purchasing officials and other engineers.

The activities governed by specifications usually

involve a much broader area of activity than the immediate project or apparatus in hand. The scope and effect of these activities demand that technical specifications not only clearly define applicable technical requirements, but also take cognizance of legal implications involved. It is indeed a common occurrence for disputes arising from specifications which are ambiguous, unclear, incomplete or unfair to gravitate to court for solution. Obviously, resort to court action is to be avoided if at all possible. Carefully written specifications can largely eliminate disagreements between parties to a contract, or at least facilitate resolution of disagreements without resorting to lengthy and costly process of court action. On the other hand, the engineer can involve himself or his principal in needless and costly legal controversy if he does not have sufficient basic understanding of the law to know when to resort to competent legal counsel in his engineering endeavors.

Persons inexperienced in this field may ask, "Why doesn't the specification just say what it means, i

engineering language?" But while, in general, it is true that statements in a specification need be understood only by those working in that particular field, still there is room for ambiguity and, therefore, the judicial construction or interpretation of contracts based on the specification must be considered. On this subject the Hon. James T. Brand, Justice of the Oregon Supreme Court, has said that, "... ambiguity ... the mother of lawsuits and the despair of engineers," and, again, "... every clause of the instrument is loaded with legal dynamite for owner or contractor." It must not be thought, however, that judicial interpretation is arbitrary; on the contrary, the court will construe specifications in the most reasonable manner possible. In its interpretation, the court will attempt to determine intention of parties by viewing the agreement as a whole rather than the parts separately, and will seek interpretations of words, phrases and technical terms which will accomplish this intention. Within this framework, ordinary words are given their ordinary literal meaning and technical words or terms are given their technical meaning, but evidence of established usage or custom in the particular field may serve to alter the usual meaning of words or terms. Supplementary to this, it may be said that a contract susceptible of more than one interpretation will be given the one that renders it reasonable, valid and legal rather than the opposite; the meaning of general words will be restricted by more specific words or descriptions; and words will generally be construed most strongly against the party who used them, that is, against the writer of the specifications or his principal. The importance of the latter point is obvious. Also, it should be noted that obvious mistakes in grammar, spelling or punctuation will be corrected; written or typed words or figures take precedence over printed ones in case of conflict; and the construction placed on the contract by the parties themselves will be given consideration.

The engineer inexperienced in specifications might say, "Well, then, I will see to it that any ambiguities be resolved by my principal," (or, in the case of construction contracts, by the engineer in charge of the project), and sprinkle specifications with such phrases as, "to the satisfaction of the engineer," and "as the engineer may direct." He may write that, "In case of dispute the decision of the engineer in charge shall be final," or, if that does not seem fair enough, he may provide for disputes to be settled by a board of arbitrators whose decision shall be without appeal. He may try to provide penalties or permit his firm or client to cancel the contract in case of non-compliance. Further, on construction contracts, he may try to provide for the engineer in charge at his discretion to take over the job on short notice.

But, these devices, if the contract is taken to court, may prove ineffective to achieve desired results. One cannot stipulate away his or his principal's obligations, or rights of the other party by a clause in the specifications. Agreements whose effect would be to deprive courts of jurisdiction are generally held to be contrary to public policy and therefore unenforceable, so that an attempt to vest final decision without appeal in the engineer-in-charge or in an arbitration board may be of no avail. However, arbitration can legally be made

How To Specify More Effective Testing

EXAMPLE:

Inadequate

One unit of each four units or fraction thereof being furnished shall be subjected to the following tests in the presence of the inspector:

Improved

One unit of each four units or fraction thereof being furnished shall be selected at random by the purchaser's inspector and subjected in his presence to the following tests, which shall be performed in the order indicated:

COMMENT:

1. Selection of samples to be tested should always be by the customer, since the manufacturer would tend to select better than average samples, whether consciously or unconsciously. Usually, samples should be selected at random, not always those on top or on the end where the best samples are likely to be. Of course, there are some instances where the buyer can, through his special knowledge, select samples lower in quality than average and assure himself that if they pass the entire purchase is satisfactory. For example, samples of rolled steel plate taken for a tensile strength test should come from the end of the plate nearest the bottom of the ingot, since carbon is lowest there, while samples for a ductility test should come from the top of the ingot.

2. In the case of many products, the order in which tests are performed can be very significant, but if a prescribed order is desired, it must be specified.

Specifications Should Specify, Not Infer

EXAMPLE:

Inadequate

Delivery shall be completed within.....

Improved

Delivery shall be completed within 90.....

COMMENT:

One additional word can sometimes resolve an ambiguity. One may think that "calendar days" would be understood, or "supplied by inference." But this is not so; 90 days may mean calendar days, working days, or, in construction contracts, eight-hour working days. Similarly when weight in "tons" is used, it should be clearly stated whether measurement is in long tons or short tons. Also, where a definite mixture of ingredients is specified, such as for concrete, specifications should state whether the ratio prescribed is by weight or volume, and with some ingredients, if dry or with a certain amount of moisture.

(Examples Continued)

How Brevity May Suffer For Omissions

EXAMPLE:

Inadequate

If air-blast power circuit breakers are furnished, the supplier shall furnish the air compressor, air receivers, and all piping, connectors and valves between the breakers and from the compressor plant. The four breakers will be located in line 40 feet apart, and the compressor plant will be 100 feet from the closest breaker.

Improved

If air-blast power circuit breakers are furnished, the supplier shall furnish the air compressor plant, air receivers, and all piping, connectors and valves between the breakers and from the compressor plant.

Not less than two motors and compressors shall be furnished, each of sufficient size to replenish within one hour the air consumed in four close-open operations of one breaker. The motor and compressors shall be mounted in a weatherproof, dust-proof housing of steel not less than No. 12 U. S. Gage, furnished by the supplier. The housing shall be provided with clamp type ground terminals. The compressor air intake shall be inside the housing, and both the compressors and the housing shall be furnished with suitable dust filters.

Each breaker shall be furnished with one or more air receivers of sufficient capacity to permit two complete close-open operations of the breaker without drawing air from the central air system. Each receiver shall be manufactured and tested in accordance with the ASME Code for Unfired Pressure Vessels, and shall be provided with a safety valve and openings for cleaning and inspection in accordance with the ASME Code. Each receiver shall also be provided with a pressure gauge and low pressure alarm contacts. Each receiver shall be hot-dip galvanized, inside and outside, in accordance with ASTM A 123-53. A manually operated valve shall be provided for draining moisture and oil from the bottom of each air receiver. In addition, the air system shall utilize air expansion, and driers and traps, to minimize the entrance and retention of moisture.

The piping between breakers and from the compressor plant shall be hard drawn threadless copper pipe in accordance with ASA B31.1-1955, Code for Pressure Piping. The four breakers will be located in line 40 feet apart, and the compressor plant will be 100-feet from the closest breaker. The piping shall be arranged in duplicate feed headers. Each line to and from each header, both at the compressor plant and at the breakers, shall be

a condition precedent to court action. Similarly, a penalty by way of punishment against one who defaults on a contract will not be upheld, while a provision for true liquidated damages or actual damages is enforceable. However, it will not avail to call a penalty by another name, for the court will look beyond the word to the intent.

There are various other reasons why a specifications clause cannot always be literally construed or enforced, but must be considered in light of public policy, equity, conscience and morals. For example, one party cannot take undue advantage of another's need or distress, or of his ignorance of a fact or condition which the first party has the duty to disclose to him. Specification requirements which are unnecessarily harsh or which seek to provide unfair privileges for the purchaser, therefore, not only tend to increase cost by discouraging some potential suppliers or contractors and causing others to raise prices to cover possible arbitrary decisions by the purchaser, but, in addition, may be unenforceable and thus avail the purchaser nothing.

Despite possible legal pitfalls, however, it should not be thought that technical specifications should be written by a lawyer. While the set of technical specifications is the heart of the legal contract, it is principally an engineering document and must be written by a technically qualified engineer. The engineer should, however, have sufficient knowledge of the law to know when to seek legal advice. He should give serious consideration to all the lawyer's suggestions, particularly what *not* to do.

Certainly, it is neither necessary nor desirable to go to extremes in writing specifications. For example, writers of commercial specifications should avoid the form and style used in some of the building codes. The obscure manner in which such codes are too often written is evident from one case in which very shortly after the 480-page code was issued, a 650-page code handbook containing the "meaning, intent and interpretation" of the code was published and became a standard reference work. Obviously, it would be extremely undesirable for specifications to contain two parts, one explaining the other.

At the other end of the spectrum are the "streamlined specifications" which are being increasingly favored, particularly in the construction field. To listen to the advocates of this style, one would think there is particular merit in the use of sentence fragments rather than complete sentences or in the use of punctuation for phrases, such as a colon for the phrase "shall be." In this style, definite and indefinite articles and phrases such as "the contractor shall," "in conformity with," and "in accordance with the plans" are to be supplied by the reader by inference. The greatest danger from using this style is that the writer, in seeking to turn out shorter and shorter specifications, will leave too much to be supplied by inference. The addition of some words of clarification, even additional pages if necessary, are much cheaper than a lawsuit brought on by ambiguity in the specification. (A wise college teacher once said with regard to engineering language and drawings, "Don't forget; if anything *can* be misunderstood, it will be misunderstood." It should be borne in mind that, while brevity is desirable, speci-

fications should have only that degree of brevity which is consistent with clarity and adequacy.)

Form of Specifications

What then should be the content, form and style of specifications? Considering first the form, we can say it is usually desirable to separate, as much as possible, general provisions of the contract from technical requirements. This presents a dual advantage. First, general provisions can be written or at least reviewed as a whole by lawyers, permitting the engineer to concentrate on technical requirements. Secondly, the bidders and the successful contractor can study technical requirements and refer to them as often as necessary without being distracted by intermixed general provisions.

As to regard to content, specifications should represent a total analysis and determination of those requirements which represent the optimum balance of three factors: desirable performance characteristics, abilities of potential bidders, and cost considerations. The resulting balance represents minimum acceptable performance requirements. The engineer should then set forth these requirements in a specification which is technically complete, clear, concise and defensible, both technically and legally, in all respects. For specifications contemplating purchase of equipment or materials, determination of requirements should include the following steps:

1. Thorough technical analysis of intended use of the equipment or materials.
2. Discussion with all interested departments or personnel the engineer's company or client to evaluate all aspects such as design, installation, operation and maintenance, while considering any special features.
3. Review of applicable national standards with an analysis to determine whether standard requirements are suitable, inadequate, or excessive for the intended application.
4. A survey to determine whether desired requirements are compatible with commercial standards and practices, and, if not, whether compromise of desired features is necessary to achieve economic feasibility. In this connection, commercial ability, as well as commercial standards, should be considered.

When information obtained from the four steps above has been gathered, it should then be integrated into a document which satisfies all aspects of proper specifications as outlined above.

Style

The writing style of specifications is, of course, inseparable from the form and content, as discussed above. Additionally, however, it can certainly be said that elegance of style must yield to clarity. Frequent repetition of the same word is far better than the ambiguity that would result from use of synonyms. In specifications, unlike most written work, lack of clarity does not merely result in academic discussion or letters to the editor, but directly affects a contract and may well have both technical and financial repercussions.

As previously indicated, specifications delineate minimum acceptable performance requirements. Work of preparing proper specifications would be

(Examples Continued)

furnished with a non-return valve and with a manual shut-off valve. All operating valves from the compressors to and including the reducing valves shall be provided with temperature protection to insure that there will be no freezing of moisture in these valves with an ambient temperature of minus 30F.

COMMENT:

1. Two motors and compressors are required for reliability and continuity of service during maintenance. Their capacity should be specified in terms of requirements.

2. Usually, a housing for the compressor plant will be required. This should be grounded.

3. Of course, the compressor air intake must be filtered. But if the housing is not filtered, large amounts of dust will be drawn in to the possible detriment of the machinery.

4. Capacity of air receivers at the breakers should be specified, even though capacity for two CO operations is normal.

5. Compliance with ASME is essential and should be indicated.

6. The valves, gauges, driers, traps and alarm contacts desired should be stated.

7. Hop-dip galvanizing is an excellent and accepted method to prevent corrosion, but it must be specified if it is desired instead of less durable paint systems, depending upon the degree of maintenance contemplated.

8. Copper pipe is ordinarily best for buried air lines of moderate pressure. Since there may be some difference in working pressure among various breaker suppliers, the rating of the piping cannot be stated, but reference to the ASA standard assures proper pressure rating.

9. Duplicate fee for reliability and continuity during maintenance or subsequent construction. Non-return valves to prevent loss of entire system in case of a leak. Shut off valves for maintenance. Temperature protection of operating valves is essential to insure functional integrity where freezing could occur.

How Restrictive Conditions Can Obligate Buyer

EXAMPLE:

Inadequate

A. All insulating oil required for the equipment shall be furnished by the contractor and shall be in accordance with the requirements of Federal Specification VV-I-530.

Improved

A. All insulating oil required for the equipment shall be furnished by the contractor and shall be in accordance with the requirements of Federal Specification VV-I-530.

B. The purchaser may or may not use the oil supplied in the equipment for which it is

(Examples Continued)

furnished. In any event, the oil used will be new oil meeting the minimum requirements specified herein. The purchaser will not maintain separate oil storage facilities for various specific makes of equipment.

COMMENT:

Both versions adequately define the type and minimum quality of insulating oil to be furnished. However, in the first version, the supplier could furnish equipment whose proper function depends upon use of oil having specialized qualities over and above the commercial grade specified. This has actually been known to occur. Acceptance of such equipment by the buyer, with full knowledge of this fact, would obligate him to maintain separate oil storage facilities to assure that oil furnished with equipment will be that which is actually used. In the event that equipment is guaranteed by the manufacturer only while utilizing insulating oil having special properties exceeding requirements of the reference standard, the buyer would be unable to recover any damages due to failure of equipment if special oil were not employed in the equipment.

The addition of Paragraph B permits the buyer to use any of a number of readily available brands of insulating oil which meet the referenced standard, where otherwise he would be restricted to use of an oil which is proprietary to the equipment manufacturer or which is not competitive with the commercial grade of insulating oil. Thus, the buyer frees himself from any obligation to maintain separate and costly oil storage facilities for each make of equipment in each station.

greatly simplified if "performance" requirements alone would suffice. However, as McCullough says, "In order to insure certain results, it has been found necessary (through long and sad experience) to specify certain methods."¹ In addition to methods, specification of materials is frequently necessary. For example, the buyer must often determine not only whether the product will meet "performance" requirements when it is new, but also he must determine at the time of acceptance whether it will continue to perform properly for the intended service life, which may be 20 or 30 years. Methods should not be controlled when the final results can be controlled. But when it is necessary to specify materials and methods, they should be specified in the most complete detail possible, with definite measurements as criteria, so as to reduce to the minimum occasions requiring interpretation by the inspector or the engineer in charge, since these decisions are subject to dispute. However, it should be borne in mind that, to the degree that materials and methods are specified, the buyer assumes responsibility for the results. Indeed, there have been instances where detailed specifications, rigidly adhered to, have

resulted in a product of poorer quality than the manufacturer's standard product and at higher cost, but with the buyer having no recourse.

Let us examine some specification phrases often used but of questionable value. One is "of highest (or best) quality." In many cases, the best quality is neither necessary nor desirable. Only a small percentage of a hog can be cut into pork loin chops, and yet the rest of the animal must be sold or waste would be tremendous and the price of chops prohibitive. So it is with many other products. Only a small percentage is truly the best, and often none is perfect. How much wood is absolutely straight-grained? If the best is needed, specify it quantitatively; if not, then specify the grade required.

Another phrase frequently used is "Blank brand or the equivalent." This is a term often used to cover the writer's lack of knowledge of actual functional requirements desired. H. L. Whittemore illustrates this pitfall with a comparison of Palmolive and Ivory soaps.² Is one the equivalent of the other, when the first is green and the second white? And, if they are equivalent despite color difference, what about yellow laundry soap? The writer should definitely state in what respect the product proposed must be equivalent to the named brand, and if he analyzes the necessary requirements sufficiently to do this, it is no longer necessary to name the reference brand. In any event, "open" specifications permitting free competition are much more desirable than restrictive specifications requiring certain brands, and, although an alternate can be proposed as the "equivalent," in effect this form comes close to being restrictive, to the detriment of the buyer as well as some of the suppliers.

Several examples of requirements written both ways (reproduced with this article) further illustrate inadequate and improved specification requirements. Deletion or addition of a phrase or sentence can clarify the intent of specifications which otherwise would be so ambiguous that interpretation in the courts might be required. By clearly defining what is intended, the engineer having specifications responsibility imparts to his company or client a large measure of protection when entering into legal contracts with equipment manufacturers.

It is readily seen that specifications engineers should highly qualified professional people with a wide diversity of technical knowledge and a good background in, or at least some acquaintance with, law. Adequate specifications not only protect the buyer, but are welcomed by most reputable suppliers. It is unfortunate that many engineers, through lack of time or experience or through lack of true appreciation of the significance of this specialized field, may not realize for their companies or clients all the possible cost savings and equipment reliability which would result from totally adequate specifications.

BIBLIOGRAPHY:

1. The Engineer at Law, C. B. and J. R. McCullough, The Iowa State College Press, Ames, Iowa, 1946.
2. Ideas on Specifications, H. L. Whittemore, Columbia, Conn., 1952.
3. Contract, Specifications and Engineering, D. W. Mead, McGraw-Hill Book Co., New York, 1933.

Economical Footing Design For Transmission Towers

By careful attention to all factors affecting footing costs for transmission towers, considerable economy can be obtained without compromising on adequate factors of safety.

By W. C. FREEMAN and
J. R. ARENA

Both of Sargent & Lundy, Engineers

INCREASED DEMAND for greater electrical capabilities of present-day transmission lines and the expected even greater increase in future lines requires larger or multiple conductors, with correspondingly greater ice and wind loads and in some cases longer spans and increased wire tensions, all resulting in heavier towers with larger and more expensive foundations.

Therefore with costs going up it is even more important now to design and install an economical foundation. Needless-to-say, a foundation is not economical if it is not safe.

Some of the problems studied and solved in the selection and design of footings for a long transmission tower line are discussed herein but most of these items will also apply to a line consisting of only a few towers.

Cost Factors Involved

There are a great many factors that affect the cost of a tower footing. Some of the most important will be covered here by the following questions:

A. Technical Decisions

1. Are the specified ice and wind loadings correct for the area in which the line is located?
2. Are the overload factors applied to these loads justified on the basis of past history and by the NESC?
3. Is the route selected the most economical or has a compromise been made to avoid the certain

areas where there is greater opposition to the line route? In a number of these cases, as a last resort, a route is selected along creek bottoms or in the hills. It must be realized that such routes greatly increase footing cost.

4. Is the route selected the most economical from an angle versus tangent ratio? Angles and dead-ends require larger and more expensive footings.

5. Are the permissible soil loads for design purposes reasonable, or has the footing been designed on the basis of a poor or average soil?

B. Purchasing Procedures

1. Are all towers purchased on the basis of bids in which competitive prices are requested, or perhaps on past practice where the towers are always purchased from one supplier? Another method is to design an efficient tower and a foundation based on soil-boring information and request bids on the specific design from several different suppliers.

2. Was the tower designer furnished sufficient information and latitude so that he can prepare an economical design?

3. Is the method one in which the bids for the individual footings are based on a "guess" for quantities of the various types of footings (in which case there might be the danger on the part of the bidder to bid high, and "play safe"), or has intelligent thought and planning been given to a program of soil sampling, thereby furnishing him with an engineering estimate with the various

types of footings that might be required? Soil sampling is discussed in more detail later.

4. Is there cooperation with the bidder on items such as furnishing designs, helping locate the line and access roads, providing adequate storage areas with sufficient railroad trackage and entrance roads? All these items help the contractor prepare a reasonable bid on the entire work as well as those items concerning footings.

C. Construction

1. After the work is awarded, there should be continued cooperation with the contractor concerning availability of right-of-way, to avoid conflict of working areas of the contractors and to have material ready when it is required.

2. Are any unjust or unreal restrictions put on the contractor's method of operation or the end result; such as requiring setting templates when these may not be necessary or requiring extremely close tolerance in footing elevation? This factor is not to be construed to tolerate sloppy workmanship on the method of construction, backfill, or the end result on any of the work.

Design Considerations

A. Loads and General Conditions

Loads on a tower consist of vertical and horizontal loads. These are transmitted down to the foundation and are then distributed to the soil. In a tower placed at an angle or used as a dead-end in the line, the horizontal loads are responsible for a large portion of the loads on the

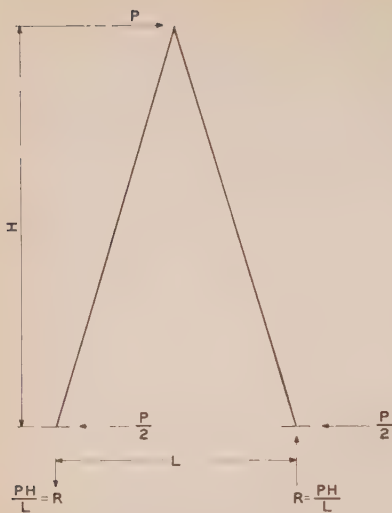


Fig. 1—Diagrammatic sketch of loads on a transmission tower.

foundation. In addition to the horizontal shear, a moment is also present at the top of the foundation creating vertical down-load and uplift as indicated in Fig. 1.

The design of the tower is closely tied in with the design of the foundation. A good tower design can be ruined by a bad foundation design. Unequal settlement in the supports of a tower can cause severe secondary stresses in the tower that may cripple it. Very often, tower failures are caused by foundation failures.

Insufficient uplift resistance in one of the footings will cause an upward movement in the tower leg with subsequent failure. After this happens, the leg settles back to its original position and remains unnoticed while the tower itself bears the brunt of structural investigation.

The tower designer has his choice of many materials for the tower, but has no choice when it comes to selecting the soil conditions at the site. Assuming that the tower cannot be moved to another location, the designer must deal with whatever soil conditions are present at the site. It is evident that this presents a new challenge for every design, for there are innumerable soil strata. But, there is one and only one type of footing that will prove to be the most economical and practical for certain soil stratum.

Time also complicates the problem. It has not been practical to plan for a line and then in sequence purchase a right-of-way, determine tower locations, and investigate the soil conditions before purchasing

the towers. The tower and footing steel are purchased long before the acquisition of right-of-way is complete and decisions must be made regarding types of footings and estimates of the depth of foundation and its area before it is permissible to enter the right-of-way in order to take borings. Later, before the foundations are constructed, the soil can be given more study, as detailed later. But this can only adapt those soil conditions to a design on which commitments have already been made.

B. Types of Footings

In general there are the following four types of transmission tower footings:

1. Grillage-type footing
2. Concrete footing
3. Drilled-in concrete caisson (auger type)
4. Piles

For most of the towers the initial choice must be made between a steel grillage or a concrete footing. Both have been used for years essentially in the same manner as originally introduced. Some variations have been the Malone-type anchor and the more recent drilled caisson. Another development is the dished-plate footing.

The choice between steel and concrete will be influenced by the availability of concrete and accessibility of the tower locations. Advantages claimed for the grillage is that it eliminates concrete and possible subsequent claims for crop damage incurred from concrete mixer trucks. Long concrete hauls are

Fig. 2—Steel-grillage type of tower footing.

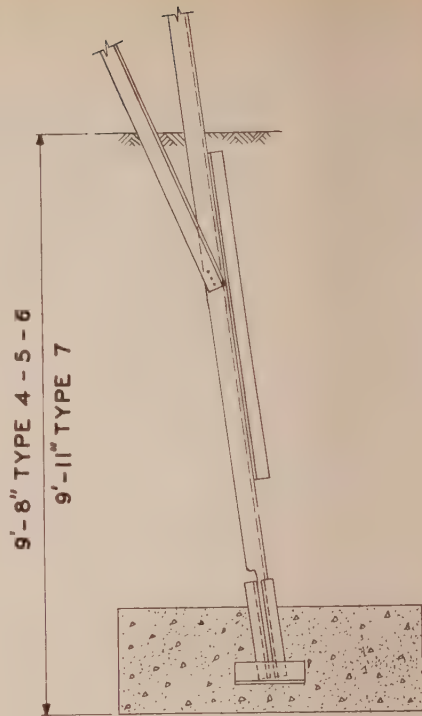
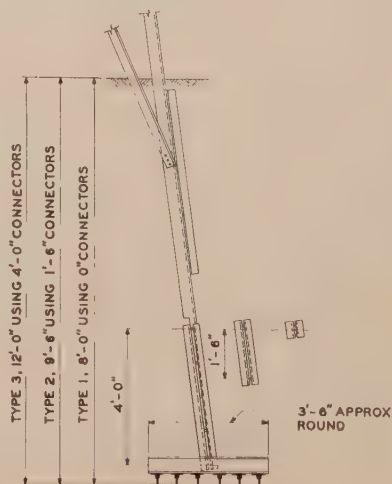


Fig. 3—Concrete footing consisting of a leg stub with a cross channel encased in concrete.

often mentioned together with low-load-limit bridges for access to the right-of-way. The steel grillage footing is attractive also since it makes for a complete purchase from one supplier of all the tower members and footings.

1. Grillage-Type Footing

The steel grillage is purchased usually on the premise that it can safely resist the uplift force by providing a resistance equal, in effect, to the weight of earth directly above the grillage and acting at an assumed angle of 30° to the vertical from the edges of the grillage to the surface of the ground. On the other hand, if it developed that the soil conditions were better than assumed when the grillage was purchased, then there would be an excess of material in the grillage together with excess excavation and backfill; making for an uneconomical installation.

This "cone" concept is completely arbitrary and fictitious, and should be recognized as such. Actually, the resistance to uplift is related to the angle of internal friction for granular materials and to the cohesive strength for clays. This will also be discussed later. Grillages up to now have generally been inflexible. If it developed that the soil conditions were worse than assumed when the

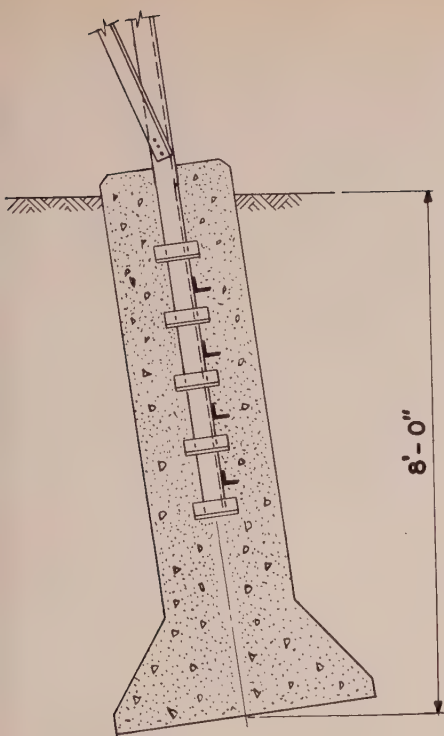


Fig. 4—Drilled-in concrete caisson or auger-type footing.

grillage was purchased, the area of the grillage was increased by encasing it in concrete, rendering most of the steel members in the grillage useless and making the entire footing uneconomical.

A new concept in grillage footings is presented here. Instead of increasing the grillage area either for bearing or uplift because of unanticipated soil conditions, the grillage is left intact and placed deeper into the ground by use of varying-length connections.

The arrangement described is illustrated in Fig. 2. Type 1 shown in this sketch is designed to safely support the downward load at 7400 psf and the uplift force based on a "cone" of 30° with 100 pcf material. Type 2 is designed for the same downward load as Type 1, and will resist the same uplift force based on a "cone" of $22\frac{1}{2}^\circ$ with 100 pcf material. Type 3 is designed for the same down and up forces, as Type 1. The uplift resistance is based on a "cone" of 15° with 100 pcf material. It is evident that with this arrangement the inflexible grillage has now become somewhat flexible.

2. Concrete Footing

A concrete footing consisting of a leg stub with a cross channel encased in concrete, is shown in Fig.

3. The horizontal dimensions of this footing can be varied to make it adequate for the various soil conditions; either for bearing or for uplift. The action here in uplift is positive since there are no open spaces for fallout material as there would be in the grillage type. The footing is both flexible and economical. It may require forming, and the backfill is still a disturbed material. This is critical in clays since they depend on their cohesive properties for resisting uplift.

3. Drilled-in Concrete Caisson (Auger Type)

The drilled-in caisson using an auger, is well suited for stiff clays and very dense granular materials capable of being drilled and standing up long enough for the installation of reinforcing steel, concrete and the leg stub. The problem of compacting the backfill is eliminated with this type of footing since there is no backfill. There is also less excavated material to be handled.

This footing is the answer to whatever qualms might exist concerning a compacted clay fill being able to provide the equivalent of a 30° cone of uplift. The shear strength of undisturbed clay is one-

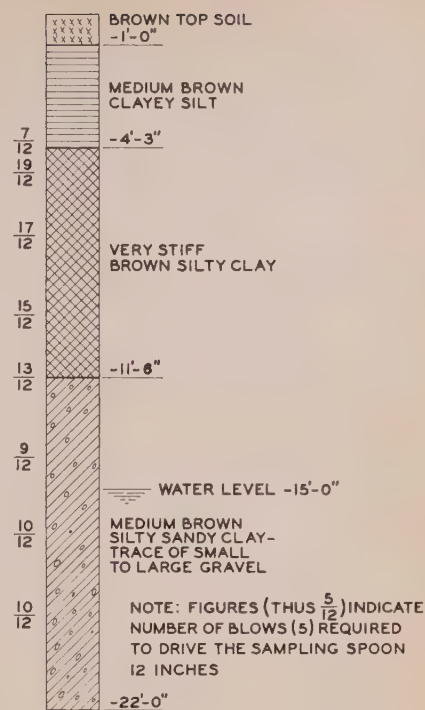
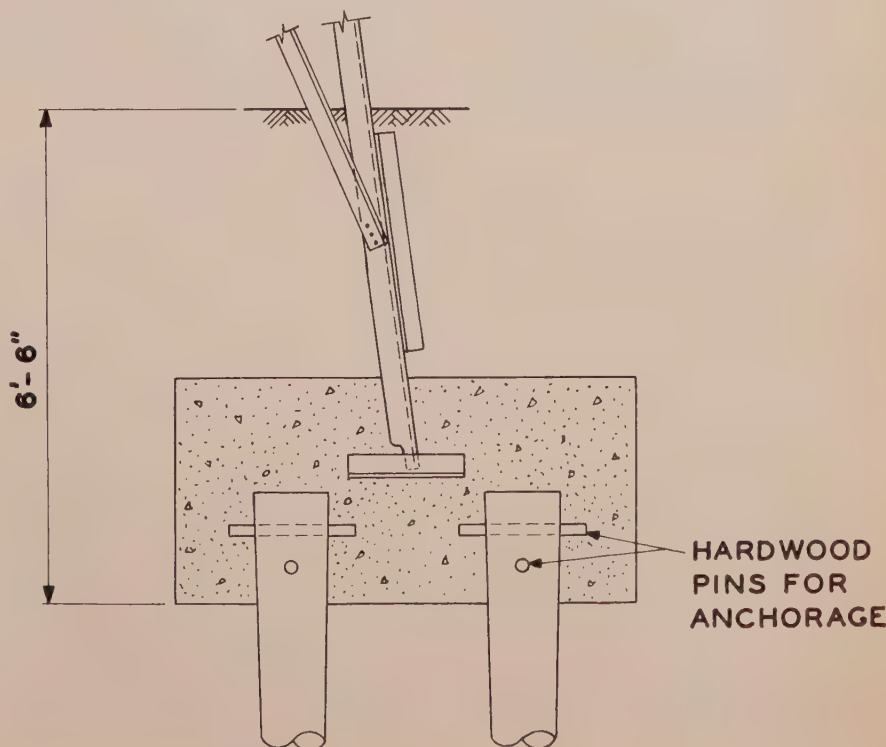


Fig. 6—Typical log of soil boring operation.

half its unconfined compressive strength. It is the shear strength of clay that resists uplift and, undisturbed stiff clays, this value is quite high and will provide at least the equivalent of a 30° "cone" of uplift. The Auger footing is also attractive for its bearing properties. With proper equipment the "bell" or en-

Fig. 5—Sketch of typical pile foundation.



DESCRIPTION OF CLAY	N	$\frac{q}{a'}$
VERY SOFT	< 2	< 900
SOFT	2-4	900-1800
MEDIUM	4-8	1800-3600
STIFF	8-15	3600-7200
VERY STIFF	15-30	7200-14400
HARD	> 30	> 14400

1. N = NUMBER OF BLOWS TO DRIVE SAMPLER SPOON 12"
2. $\frac{q}{a'}$ = ALLOWABLE SOIL PRESSURE IN LB. SQ. FT.
3. SOURCE: "SOIL MECHANICS IN ENGINEERING PRACTICE"
BY TERZAGHI & PECK

Fig. 7—Proposed allowable bearing values for clay as related to the number of blows on sampler tube.

larged portion of the footing can be increased to give a larger area for both bearing and uplift.

Fig. 4 shows a typical Auger pile. Standard-size reamers reported by one driller are 18", 24", 30" and 36" shaft diameters and the amount of under-ream can be varied from a few inches to as much as 84" bell diameter.

4. Piles

Piles should be considered only when a good bearing stratum does not occur at footing depth, or at a reasonable distance below. For example: A tower footing is to be placed 8'-0" below the ground. The boring at this depth shows 3 blow submerged fine sand. This layer extends down to 35' before a good founding material of 18 blow sand is reached. It would certainly be impractical to extend a concrete foundation down to this depth, as the dewatering, sheeting and excavation costs, as well as the concrete cost would be prohibitive. Therefore, piles should be driven to engage the firm strata until the required penetration is reached. Fig. 5 shows a typical pile foundation. The hickory pins in the pile are for connecting the pile to the concrete pad for the purpose of resisting uplift.

Selection on Basis of Soils

The design and purchases should include footings with several different dimensions so they can be assigned to specific towers to suit the actual conditions. Before the erection contractor starts to work, the right-of-way will be available for a more detailed review of the soil and the final selection of footings for each tower.

A. Types of Soils

There are, generally speaking, three types of soils existing:

1. A pure cohesionless, granular, pervious material—sands.
2. A pure cohesive fine-grained, relatively impermeable material—clays or silts.
3. A mixture of the two—sand and clay.

Then there are loams and many other types which are variations of the above three mentioned categories. The physical properties of sands are simple, those of clays are very complex and those of a mixture of sands and clays are even more complex.

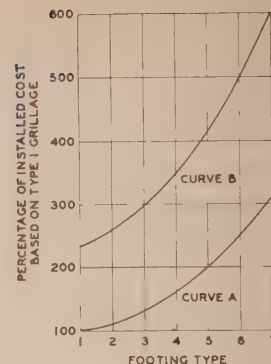
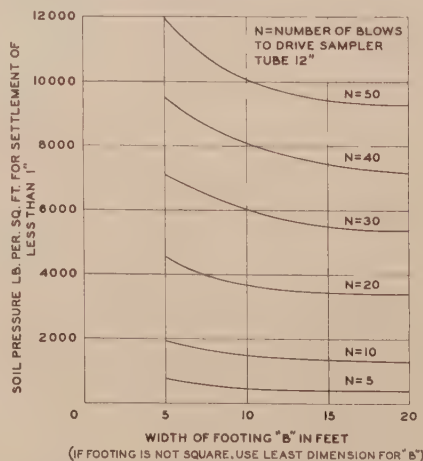
For an excavated footing the best backfill material for uplift is sand and/or crushed stone or gravel. These materials generally possess a minimum angle of internal friction in the wet or dry state of 30° and will generally provide a "cone" of 30°.

B. Soil Borings

The steel in a tower possesses known and determinable quantities, whereas the properties of the foundation material for a tower besides being not visible are very complex and borings should be taken. A soil boring is a guide, a clue to the type of soil and its strength in resisting the forces on the tower. On a recent midwest 230-kv transmission line with over 300 steel towers, 147 borings were taken at a cost of \$20,000, averaging \$294 per mile of line.

This cost is small compared to the line cost per mile. Some have the viewpoint that it would be cheaper to omit borings and design a more conservative footing. The purpose

Fig. 8—Soil pressure corresponding to 1" settlement of footings on sand.



1. CURVE A: MATERIAL & LABOR COST—NO PUMPING OR SHEETING
2. CURVE B: MATERIAL & LABOR COST—INCLUDING PUMPING & SHEETING
3. DESIGN BASIS FOR CURVES A & B

FOOTING TYPE	ALLOWABLE BEARING PRESSURE LB. SQ. FT.	ANGLE OF CONE*	WEIGHT OF EARTH LB. SQ. FT.
1	7400	30°	100
2	7400	22½°	100
3	7400	15°	100
4	3500	15°	80
5	2200	SIZED ON BEARING	
7	1000	0°	65

Fig. 9—Installed cost relationship for various types of footings all designed to support the same load.

of borings is primarily to insure an adequate and safe foundation. Whether this is more expensive than a haphazard guess at a foundation is secondary. The primary concern should be one of safety.

No foundation could possibly be designed for the worst soil condition. There is no limit as to what the worst soil condition could be. On a recently-designed line the footing cost ranged from \$400 to \$40,000 per tower. The \$40,000 was the cost for pile foundations including pumping and sheeting. Fortunately the nature of soil at each of these locations was known beforehand from the borings and the proper foundation was designed. Without the borings, how could any foundation have been designed safely at the \$40,000 location?

A typical log of soil boring operation is shown in Fig. 6. The figures in the left-hand column represent the number of blows necessary to drive the sampler tube 12" into the ground. From this information, data pertaining to the bearing value and uplift resistance can be determined.

Fig. 7 shows the recommended bearing values for clay as related to the number of blows.

The success of any clay backfill for resisting uplift depends on how well the material is compacted in the field. If there were some way of miraculously embedding a grillage into clay without disturbing the soil (which is achieved with some drilled caissons), we would have a

very good material for resisting uplift. Stiff clays have excellent cohesive properties, but since a clay backfill is definitely a disturbed material, its properties must be reviewed critically.

Fig. 8 shows allowable bearing values for sands when the settlement is limited to 1". Allowable bearing values for 2" settlement are twice the values shown, and three times as much for a 3" settlement. Values taken from these curves should be compared with the ultimate bearing values of sands and the lesser of the two values should be used.

Economic Factors

The principles outlined in this paper were applied to a particular line and the results of the bids obtained for the different conditions were analyzed and are shown in Figs. 9, 10, and 11.

Seven different footings, each given a type number, were developed for the tangent tower as listed in Table I.

Fig. 9 shows the variation in the installed cost for these seven footings utilizing the labor costs of the successful bidder and the actual material cost.

Two conditions are shown in Fig. 9. The first is Curve A, which shows the variation in installed cost of the seven types based on the type 1 grillage, with no pumping or sheeting. The second is Curve B which shows the same relationship but including pumping and sheeting costs.

It will be noted that there is not too great an increase in cost at the lower part of Curve A but that the cost increases rapidly as the footing size increases. This is even more true for Curve B, particularly for the larger footings, with the pumping and sheeting costs. A concrete footing requiring pumping and sheeting might cost six times as

PERCENTAGE OF INSTALLED COST BASED ON TYPE 1 GRILLAGE

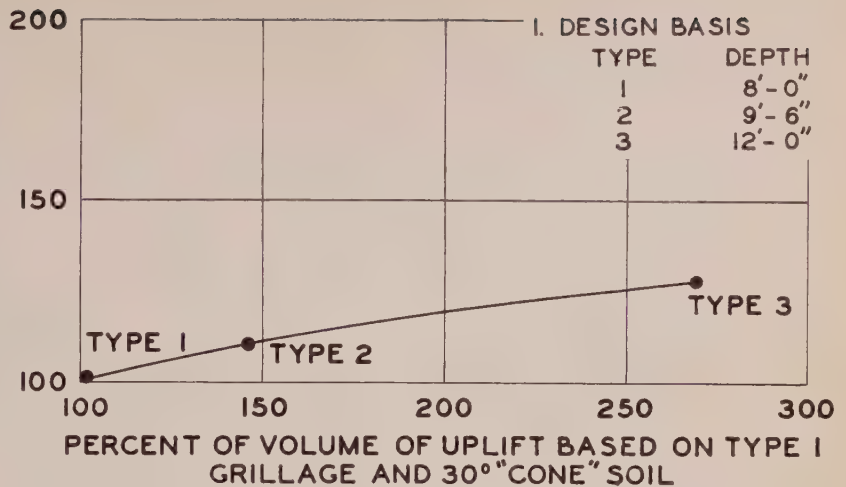


Fig. 10—Installed cost relationship vs increase in volume of uplift of a footing as depth increases.

Fig. 10 shows that when both footings are placed in a soil developing a 30° "cone" and weighing 100 lbs/cu ft that footing type 3 will support in uplift 2.7 times the load of footing type 1.

This relationship of comparing the volume of uplift for footing types 2 and 3 to type 1, together with their installation costs, is shown in Fig. 10. Fig. 11 shows the similar relationship of cost versus volume of uplift for footings type 5, 6 and 7 as compared to type 4. Therefore, Fig. 10 compares the grillages and Fig. 11 compares the concrete footings.

For both Figs. 10 and 11, average installation costs were obtained by
(Continued on page 108)

Fig. 11—Installed cost relationship vs increase in volume of uplift of a footing as size increases.

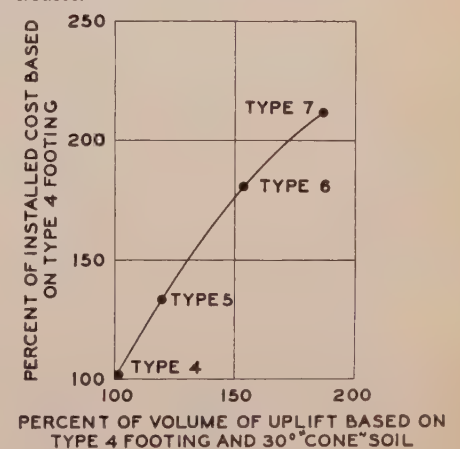


TABLE I

Different Footings Developed For A Tangent Tower

Type No.	Description	Depth
1	Grillage approximately 3'-6" dia.	8'-0"
2	Same	9'-6"
3	Same	12'-0"
4	Concrete 4'-0" square	9'-8"
5	Concrete 5'-0" square	9'-8"
6	Concrete 6'-6" square	9'-8"
7	Concrete 7'-6" square	9'-11"



Left: It's a far reach to transport this replacement pole to the rear lot line. But lack of any other access forces San Diego Gas & Electric to resort to this method where such situations exist on their system.

SOMETHING akin to sky hooks are needed by the San Diego Gas & Electric Company when pole replacement becomes necessary on some of its distribution lines.

Back-lot power-line construction, with no direct access for maintenance purposes, has created this problem.

Pictured here is the technique utilized by this utility in overcoming the handicap thus created. A high-lift mobile crane operating from the street transports the pole over the tops of the houses and places it in the hole at the rear of the lot.

No utility would adopt such a procedure if it could be avoided. But such a spectacular approach as this should impress the citizens of San Diego with the company's determination to maintain service despite all obstacles.

POLE REPLACEMENT THE HARD WAY

San Diego utility resorts to "boardinghouse reach" technique in replacing a pole to a rear lot position when all accesses have been blocked.



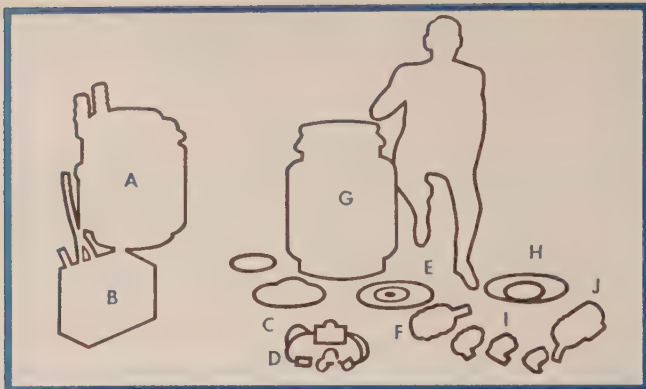
Above: This pole-replacement crew is forced to work in very close quarters where the "boarding-house reach" technique is compulsory due to lack of other access.

Left: Television antennas reaching high into the sky from nearly every roof top add to the ticklishness of this pole-setting job.

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(A) NEW G-E DISTRIBUTION TRANSFORMER; (B) Permallex* insulated coils; (C) Melalast* finish cover; (D) breaker with new settings; (E) Nitrile rubber gaskets and overload light; (F) new high-voltage bushing; (G) steel tank; (H) stainless steel clamps; (I) Strenicor terminal clamps; (J) Thyrite* Magne-valve arrester.

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J. O. SWEENEY, Manager—
Product Planning, Distribution
Transformer Department, and
the components of a General
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General Electric distribution transformers feature Permalox insulation for 20% added loadability—*plus* important bonus features that can mean day-to-day savings in operation and maintenance. For example:

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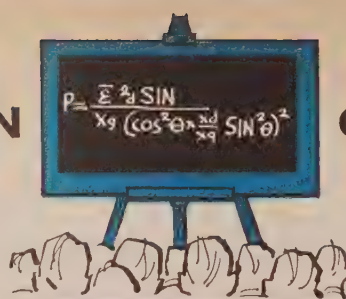
Strenicor terminal clamps virtually eliminate secondary failures.

Thyrite Magne-valve lightning arrester provides optimum protection against lightning surges.

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Voltage Ratio And Phase Device Shown At Doble Conference

A portable apparatus performing the functions of a potential transformer for transmission voltages but weighing less than 50 pounds that can be carried in the trunk of an ordinary automobile was described at the 27th annual conference of Doble clients held in Boston January 25 through January 29, 1960. The device when connected to the potential tap of a bushing of known capacitance and power factor, can establish a low voltage in the order of 100 volts and whose phase can be controlled to coincide with the transmission voltage. Ratio of high to low voltage can be established at one of several common values from 600/1 to 3000/1 so that line voltage can be read on a voltmeter by applying the ratio selected.

The device, said Doble engineers, can be set up in 15 to 20 minutes as compared with the several hours required to set up potential devices. The device then provides a low voltage in the desired ratio and in phase with the high voltage which is available for measurements and as a standard with which potential devices can be set up quickly and accurately.

Lightning Protection

Experience with Cougnard Deionizers is confusing, said A. J.

Devereaux, Illinois Power Company, because of the unusual nature of troubles reported. Burning of guy wires below wood strain insulators has been found in several places but no conductor burns have been reported. Outages continue on the Cougnard-protected line, he said, but not enough experience has yet been obtained for final decision. "From the experiences outlined herein," he concluded, "we are not ready to agree that the Cougnard Deionizers give superior protection to our lines when compared to the conventional lightning protective equipment. They do show considerable promise so careful records will be kept for the next few years on their operations."

Much the same experience with Cougnard Deionizers was described by five other companies that have experimented with these devices. Typical comments were, "not enough experience yet to tell," "not much difference," "apparent decrease but other troubles such as with small animals or birds," E. L. Schlottere, Philadelphia Electric Company, said that while line trips were reduced 17 percent on a Cougnard-protected line, faults caused by animals and conductor and insulation damage, mainly at Cougnard installations, had in-

creased markedly. He suggested that low BIL of Cougnard devices and heavy duties on Philadelphia circuits might have some effect, and that his company feels that further testing of them is unwarranted and is removing them.

Number of successes in reducing or eliminating insulator flashovers due to airborne contaminants through use of silicone compound smeared on the insulators continues to increase, said F. A. Smith, Dow Corning Corporation. It is an established, proven material that decreased probability of outages and lowers maintenance costs on lines where insulator contamination is a problem, he said. O. R. Compton, Virginia Electric and Power Company, supplemented these comments by saying that on one line near the ocean where five separate flashovers had occurred in one day due to contaminants, no flashovers had occurred since application of silicone compound in 1958.

Field tests on lightning arresters at full rated voltage can be obscured by grading current passing through resistors shunting the gap which can hide or confuse measurements of current leaking through or over contaminants on the porcelain, said W. H. Eason, General Electric Company. Faulty arrester insulation can best be detected through leakage-current tests at a low percentage of rated voltage, he concluded. He suggested that after tests have been made on dry arresters that additional tests could be made after external porcelain surfaces have been carefully and thoroughly wetted.

Some utilities felt that there might be considerably more value to field tests of lightning arresters than was indicated by the GE author and suggested measurement of sound-value level. Another suggestion was for a hot-collar test which was challenged by Mr. Eason

Some of the chairmen of the Doble Client Committees were, left to right, R. E. O'Leary, Ohio Power Company; E. W. Hand, West Penn Power Company; R. A. Horenburger, Philadelphia Electric Company; E. L. Schlottere, Philadelphia Electric Company; and G. W. Early, Metropolitan Edison Company.



on the ground that current flow would be both inside and outside the insulating shell. J. R. Bracewell, Georgia Power Company, felt that faulty lightning arresters can be definitely indicated in the field through Doble tests and cited several examples.

The watts-loss method of testing for dielectric losses in switch sticks and in hot-line tools continues to be most successful with regular untreated or varnish-coated wood sticks or with the newer plastic-coated hot-line tools, reported S. H. Osborn, Jr., and G. W. Armstrong, Jr., both of Doble Engineering Co.

Describe Bushing Tests

An ionization-pulse-detection method for making corona detection tests on high-voltage bushings which was described in AIEE paper CP-58-107 is bringing to light faulty bushings on the TVA system said C. A. Duke of that organization. Notwithstanding success with this method, such tests are expensive, he said, and will be made, at present, only at generating plants or substations where a failure occurs.

C. M. McCoy, Central Illinois Light Company, told of the method used by his company to detect defective solder seals in bushings. A gasketed gauge glass, three inches in diameter, is placed over the top terminal of the bushing. A top metal cover plate has provisions for vacuum and oil connections. A leather belt around the bushing porcelain makes it possible to hold this assembly in position with rubber bands made from inner tubes. The glass is partially filled with oil and a vacuum is drawn above the fluid. If the seal is defective, air bubbles will appear.

Maintenance of vacuum interrupters on Bonneville Power Administration lines was described by C. C. Diamond of that organization and by H. H. Schwager, Schwager-Wood Corporation. Interrupters are maintained about six months after initial energization and annually thereafter, they said. It is particularly important that all set screws, bolts, and nuts be checked for tightness since any slippage will affect total travel of the tubes which amounts to only 5/32 in. A simple 60-cycle hi-pot test of 50-kv peak voltage has been found to give good

results in determining when individual tubes have reached the end of their expected life. Intermittent or continuous breakdown, luminescent glow, or excessive current flow during this test furnish positive indication of excessive deterioration. Darkening of the area of the arc shield near the contacts is an indication of the amount of current or number of operations that have occurred. This darkening does not reduce interrupting capability of the tube until the entire length of arc shield is coated.

Tests On Apparatus Insulation

What in effect was an accelerated-life test on a 3000-hp motor was described by D. J. Goodman, Arnold Engineering Development Center. Unusually large number of starts and stops of this motor powering a small wind tunnel were expected to reduce normal 20-year life of a motor to about five years. The preventive maintenance program included frequent inspections and insulation tests. Stator-winding wedges became loose after slightly more than a year of operation and the motor was completely rewedged. It was necessary to repeat this rewedging a year and a half later. Insulation testing scheduled at six-months intervals included power-factor testing, insulation-resistance measurements, and d-c high-potential testing up to 15 kv to ground but no indications of incipient failure were found with these tests before actual failure. A high Polarization Index number of 7.0 just before failure might have pointed to impending failure if numbers of 5.5 and 6.0 had not been found previously, he said.

Added valuable information concerning amount of ionization in rotating machines can be obtained through use of a radio-influence-voltage meter as well as by measuring power-factor tip-up with increasing test voltage said E. H. Povey, Doble Engineering Company. While both methods depend upon total ionization and hence give evidence of localized troubles, it is hoped that even better methods will be devised in the future, added Mr. Povey.

Frequent measurement and recording of power factor of insulating oil during an accelerated life test

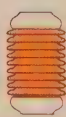
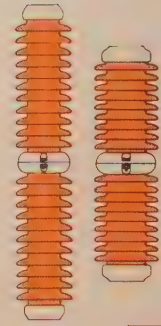
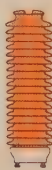
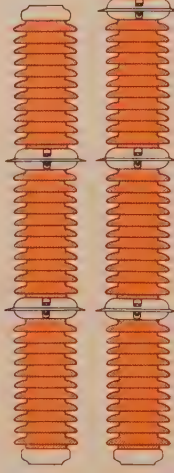
under oxidation serves as a "signature" of any given oil said F. S. Oliver, Doble Engineering Company. Comparison of this curve with curves of oils of known good qualities shows significant differences that can be interpreted readily as to quality of the unknown oil, he said. Thus, average power factor of good oils remains below 2.5 percent with a time to peak of 8 to 18 hours, and with a peak height of less than 5 percent. It is interesting to note, he said, that during the first 15 to 20 hours good oils show a rise in power factor to a peak, after which the power-factor values decrease to a low point and then gradually rise again as the oxidation cycle continues.

Several theories have been advanced for this shape of curve, continued Mr. Oliver, but the one believed to fit observed facts most closely is that initially-present corrosives, as well as latent corrosives not completely removed by refining are activated by heat and oxygen and react with copper to form metallo-organic compounds which ionize and increase electrical losses in proportion to their concentration. Simultaneously, certain aromatics are oxidized, but more slowly, to form natural inhibitors which chelate the ionized copper into an unionized form, which accounts for the drop in power factor. As oxidation continues, the natural inhibitors are gradually used up and the chelated copper complexes are oxidized to ionized forms, increasing the power factor again. The combined test is called the Doble Power-Factor Valued Oxidation test.

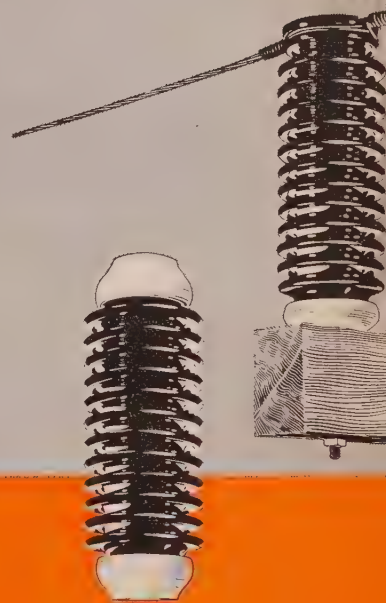
It is important to reclaim transformer insulating oil in the field on live transformers, said J. R. Bracewell, Georgia Power Company. Reclamation of oil in the laboratory does nothing about sludge and other contamination imbedded in a transformer oil ducts and insulation, he said. However, as the acids and contaminations are removed from the oil when reclaiming in place, the clean oil acts as a solvent for the sludge in windings and insulations and at this time some of the sludge will be removed during the reclaiming.

(Continued on page 92)

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- 1954 **FIRST** Line Post for 115 kv 
- 1955 **FIRST** Distribution Posts 
- 1955 **FIRST** Station Posts for 230 kv and 345 kv 
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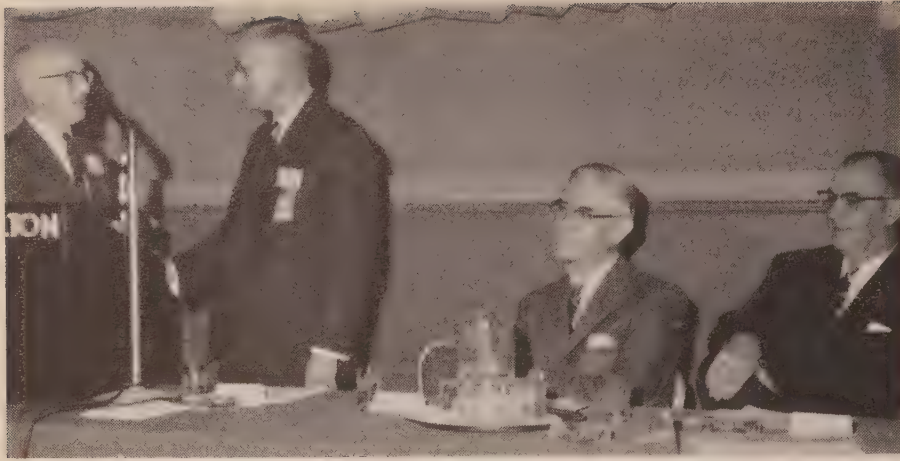
But it took years. And of course competition sniped away. Between times, they tried to copy Lapp's design, but without Lapp's patiently-acquired skills and techniques in ceramic manufacture. Now that Lapp Posts have been accepted, there is less sniping, more copying—endorsement of the fact that our baby has come of age.

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Edison Medal being presented to AIEE Past President James F. Fairman, Con Edison vice president (second from left) by J. H. Foote, Commonwealth Associates, Inc., president of AIEE (at left). At right are H. C. Forbes, Con Edison board chairman, who described the career of the Medalist, and A. C. Monteith, vice president, Westinghouse Electric Corp., chairman of the Edison Medal Committee.

Eble Reports Russian Power Lag to AIEE Cites Engineering Talent Development Need

The Russians appear to lag well behind the United States, not only in steam power generation, but also in power use, Charles E. Eble, president of Consolidated Edison, told the American Institute of Electrical Engineers at the General Session of the Winter Meeting in N. Y., February 1, 1960.

Reporting on his recent trip to the Soviet Union, Mr. Eble said that in terms of total capacity, at the end of 1958 Russia had 53-million kw compared with the U. S.'s 160-million kw. Russia plans to have 113-million kw by 1965, at which time the U. S. expects to have 250-million kw. Thus, the gap between U. S. and Russia, which was 107-million kw in 1958, will have increased to about 137-million by 1965, Mr. Eble said.

In Soviet Russia, 80 percent of their power goes for industry and a mere 20 percent for residential, farm, and all other uses. Their average home use is 400 kwhr per year, as against our 3400, he declared.

New Engineering Talent Needed

The ability of the U. S. to meet Soviet challenges in the electric power, as in other fields, hinges importantly on our continuing success in developing new engineering talent, Mr. Eble continued. They have employed incentives which make it

so desirable to be an engineer that there are thousands more candidates than could possibly be used. They have glamorized the profession and pay higher rates for engineering talent in terms of money and preferential treatment. They completely finance the education and training of young people qualified and selected for engineering careers, he said. They are obviously building for both the present and the future by creating a vast pool of engineering talent.

In a free society, however, we cannot direct people into the engineering field.

Fairman Honored

James F. Fairman, senior vice president of Con Edison, was presented with the Edison Medal For 1959 by AIEE President J. M. Foote, Commonwealth Associates, Inc. This is the highest award by AIEE. Mr. Foote said that Mr. Fairman was chosen for his outstanding performance in improving the design of large electric power systems, and for his work in the atomic field and his efforts to improve the engineering profession.

Engineering Responsibilities

In responding to the Edison Medal Award, Mr. Fairman said that one of the great responsibilities of the engineering profession is to

advance the art of atomic power production so that this new source of energy may be brought to commercial development in time to supplement and ultimately to take the place of the earth's diminishing store of non-renewable energy resources. Its second major responsibility is to devise ways and means of tapping atomic energy and other energy sources economically and safely, he continued.

A third responsibility is to obtain public understanding of the engineering problems involved in our work, and public acceptance of the results we achieve, Fairman stated.

Expand AIEE Facilities

In addressing the General Session, AIEE President J. H. Foote urged the expansion of the Institute's potentialities to include the requirements of the very considerable number of young engineers who will join year by year. He also urged the adoption of new methods and facilities to better serve the membership's essential needs. But we must have courage to adopt or to discard, if need be, those facilities which have served well, but which need to be brought into tune with any determined realignment of our program, Foote said.

New President Nominated

Clarence H. Linder, vice president of General Electric Co., was nominated as next president of AIEE at the general session. Linder has been connected with G-E since 1924 and has managed both engineering and manufacturing operations ranging from heavy apparatus to consumer goods. In 1950 he was named general manager of the Company's activities in the large appliance field. From 1953 through 1959, Linder was vice president-engineering and a member of G-E's Executive Office. Early in 1960 he became vice president and group executive—Electric Utility Group.

Directors Nominated

AIEE directors nominated were: Robert B. Gear, Commonwealth Edison; Charles T. Hatcher, Con Edison; and Cullen T. Pearce, Westinghouse Electric Corp. W. R. Clark, Leeds & Northrup Co., was nominated to be treasurer.

(Continued on page 95)

Transmission: Let's Go Higher, But Let's Standardize on 500kv Now—Sporn

Higher transmission voltage was the subject hub about which many hours of discussion revolved. Summary: Much investigation still needed, but well under way.

Five papers, mainly by General Electric Company authors, were presented detailing progress on Project EHV, a prototype three-phase line being constructed near Pittsfield, Mass., intended to be operated at voltages as high as 750 kv to permit study of factors affecting design and operation. It is expected that the line will be energized next May.

International standardization of 500 kv as the next step in voltage for long-distance, high-capacity transmission, with consideration for a second step of 690 or 750 kv for the distant future was urged by Philip Sporn and H. P. St. Clair, both of American Electric Power Service Corp. This would be instead of 460 kv being considered in Project EHV.

Optimum configuration and conductor area may be determined for a given extra-high-voltage transmission line using a method embodied into an IBM-705 digital computer program. The method, described by P. A. Abetti, C. B. Lindh and H. O. Simmons, Jr., all of General Electric, is general, and applicable to a wide range of system configurations, transmission distances, voltages, and loadings per circuit. Economic evaluation factors may be varied to agree with available cost data, and utility management's judgment and policies.

After using the method on 58 different cases where system parameters were varied with economic evaluation factors, the authors concluded that non-expanded multiple conductors will meet requirements of EHV transmission systems of the future up to 650 kv. However, they said, "Single conductors per phase, and possibly dual appear to be im-

(Continued on page 96)

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practical for 650-kv transmission."

Insulation and arresters for project EHV, said J. G. Anderson, J. H. Hagenguth, I. B. Johnson, and A. J. Schultz were to be successively at two levels, first for 460 kv + five percent and later at 650 kv + five percent. Operation at 500 kv would be with 460 kv insulation and equipment and at 750 kv would be with 650 kv insulation and equipment. Line switching-surge strength in establishing insulation levels and will be based on a maximum expected switching-surge amplitude of 2.4 to 2.5 times crest of the normal 60-cycle voltage predicated on use of air circuit breakers and no restrikes. Line wet 60-cycle strength is to be at least twice maximum overvoltage that will occur during fault conditions and greater if possible.

It is essential, said P. A. Abetti, D. D. Davis, and J. H. Hagenguth, that experimental transmission lines for investigation of higher transmission voltages be designed for specific operating voltages rather than to try to interpolate or extrapolate between values found in lines built to cover a wide range of voltages. Project EHV will be operated first at 460 kv and probably later at 650 kv. Various conductors and line configurations will be tried at these voltages so that by comparing alternate solutions under similar environmental conditions the optimum solution will be found.

Problems in connection with selecting conductors for EHV were discussed in a paper by J. J. LaForest, J. Kaminski, Jr., and R. E. Larson. Selections have been made for 460 and 650 kv using studies based on generation of radio noise from small points placed on conductors and using the Swedish 400 kv lines as a reference which have also been found in good agreement with Dr. Adams' theory of radio noise. Extension work continues, they said, in extending Dr. Adams' theory on an absolute basis. There is little difference, they added, in radio-noise generation characteristics between configurations having bundle spacings of 16 inches and those with bundle spacings of 18

inches. Even a bundle spacing of 7 inches would be advantageous for radio-noise considerations.

Radio noise on transmission lines is assuming greater importance as total mileage of EHV lines increases. While noise generation by corona has been given heavy attention, the other two parameters—propagation of noise energy along the transmission line, and the magnetic field factor—have received least attention to date. Paramount unknown in noise energy propagation is attenuation.

Radio Noise & Corona

L. O. Barthold, General Electric presented attenuation data and comparisons of calculated and measured field factors for each of the six practical characteristic modes of propagation of AEP's Dequine-Olive double-circuit, 345 kv, vertical-configuration transmission line. Co-authors were J. J. LaForest of G-E, R. H. Schlomann, American Electric Power Service Corp., and F. J. Trebby, Kaiser Aluminum and Chemical Corp.

Results: Attenuation constants at 1040 kc are 3.6 db/mile for the line-to-ground mode, and 0.13-0.75 db/mile for the other modes; at 190 kc, line-to-ground attenuation for the remaining modes is 0.08-0.20 db/mile.

Less radio influence is expected on a new 90-mile, 345 kv transmission line built from Chute-des-Passes powerhouse to Isle Maligne in Canada than has been found at standard 230 kv construction, said H. B. White, Aluminum Co. of Canada, Ltd. Two 850 mcm ACSR conductors with 1.099 in. diameter bundled horizontally at 16 in. are expected to give RI and corona performance equal to or better than that of a single 795 mcm, 1.108 in. diameter conductor operated at 230 kv, he said.

Corona is, of course, of prime concern in high-voltage transmission. Preliminary study of characteristics and methods of measurement of corona, said A. H. Foley and F. Olsen, indicates that presence of one or more harmonics in the voltage wave acts as a control signal for fundamental frequency corona losses and may cause these

to be either increased or decreased. For a five-percent harmonic, increase can exceed 100 percent, they said. Influence of a harmonic voltage appears to be most pronounced when the fundamental-frequency power factor of the line is in the region of one percent. The high-voltage bridge has been found satisfactory for such measurements.

Operation

Tighter conductor stringing on transmission lines can result in substantial savings in first and annual costs, reported Eduard Fritz, Potomac Electric Power. However care must be used in treatment of broken-wire load when greater tensions are used. The author suggested that manufacturers and utility companies increase efforts to perfect hardware that will permit greater conductor tensions.

Galloping instability of transmission line conductors is an example of a self-excited vibration caused by aerodynamic forces acting upon a non-circular cross section, according to W. N. McDaniel, Baltimore Gas & Electric Co. There are mathematical techniques available for studying in detail this self-excited motion. Before a practical solution can be obtained, accurate data on conductor damping, modulus of shear and the characteristics of the aerodynamic forces acting on almost circular cross sections must be accumulated. Such an approach has promise of giving the industry an early practical solution, McDaniel concluded.

Experiments with the operation of a power line carrier system during sustained line faults have shown that a carrier operating range of about 60 db. in addition to that required for normal line attenuation, should provide reliable communication under sustained fault conditions when line-to-ground coupling is used, reported D. E. Jones, Ontario Hydro. The advantage of line-to-line coupling over line-to-ground during severe faults is about 8 db. Operation of carrier when more than one set of working grounds is on the line may not be practical, he said.

A new method of making transmission loss formulas by means of

AIEE—continued

eigenvalues and modal matrices was described by E. E. George, Ebasco Services, Inc. This method, using a digital computer, is direct and is more accurate than any previous method. Although based on a relatively advanced mathematical technique, and one that has only recently been developed for digital computers, the utility engineer can use the method without understanding the theoretical background, Mr. George stated.

Insulation

A test method has been developed, said A. D. Lantz, Jr., Ohio Brass Company, that provides a precise indication of inherent dielectric strength average and dispersion under impulse conditions of high-voltage insulators. This is accomplished, he said, using techniques within reach of many laboratories equipped with an impulse generator and associated recording equipment. The test can be interpreted to provide a fairly complete understanding of dielectric strength requirements. It would appear, he added, at this time that a critical rate of rise of 1000 kv per microsecond or even less would be conservative as a design requirement.

Protection

"As transformers continue to become of larger capacity and of higher voltages, it is imperative to retain, if not to improve, the sensitivity of the fault detection system," said L. C. Aicher, Allis-Chalmers Mfg. Co. To achieve this when using the ground current technique, he concluded that: (1) It is undesirable to use additional capacitance in parallel with the resistive shunt, since it may completely mask evidence of failure. (2) Increasing the resistance in series with the winding under test reduces the sensitivity of the ground current system as a fault detector. This includes resistance used to raise shorter than 40 microsecond wave tails. (3) Practical ground current records can be made by permitting the initial capacitance current spike to traverse off screen for the brief instant of its duration.

A graphical method for evaluating effect of nonstandard lightning

surge voltages on equipment insulation was presented in a paper by G. D. Breuer, R. H. Hopkinson, I. B. Johnson, and A. J. Schultz, all of General Electric Company. Not only is the method simple to understand and very easy to apply to surge evaluation, they said, but it is also considered sufficiently accurate to be extremely useful in measuring relative effect of surge voltages.

Transformers

As transmission voltages climb, the utility industry may be heading for trouble in gas-pressure oil insulation systems in large high-voltage power transformers, because of bubbles in the oil. According to A. Y. Chadwick, D. H. Ryder and A. E. Brierley, all of English Electric Co., Ltd., gas bubbles may be released from a super-saturated oil under the direct influence of dielectric stress in the inner regions of an insulation structure, where small pockets of gas may be formed. "Such can lead to corona discharges which by electro-chemical interaction in presence of nitrogen, oil and copper, can cause deposition of semi-conducting copper sulphide particles on the insulation surface in the vicinity."

Corona tests on gas-pressure sys-

tem transformers obtained in both laboratory and field investigations, indicate that after two or three years of service during which measurements have shown appreciable corona activity, the corona can be temporarily eliminated by refilling under a high degree of vacuum treatment.

"As gas-bubble evolution is the direct and natural result of varying gas pressure at the oil surface, the continued use of such constructions should be reviewed," the authors said.

Data was presented in a paper by M. W. Schulz, Jr., and R. J. Ringlee, both of General Electric Company intended to assist power-system designers in arriving at specifications for permissible transformer sound levels in cases where present standards are not adequate. Charts showing distribution of levels of transformer core-noise harmonics, of relative octave-band noise spectrum of a typical fan, of minimum night-time ambient noise spectra, and of public response related to level of transformer harmonic and spectrum level of ambient at the frequency of the transformer harmonic were given, and methods of arriving at the conclusions were described.

In Distribution: Digital Computer Giving Planning The Attention It Deserves

Economics of distribution—long a "planning plager"—is a "natural" for digital computer attack. Both utility and manufacturer are taking advantage of it more and more.

Results of a digital computer study of economic distribution system design from primary feedpoint through the secondary system were developed by H. E. Campbell, R. C. Ender, M. W. Gangel and V. C. Talley, all of General Electric. Secondaries studied were 120/240-v and 240/480-v single-phase. All costs used in the study were estimated realistically as possible.

The study revealed that the 120/240-v linear-coverage secondary system is generally more economical than 240/480 v when served by a 4.16 or 12.47-kv primary. However, a three-kva autotransformer was included in the 240/480-v sys-

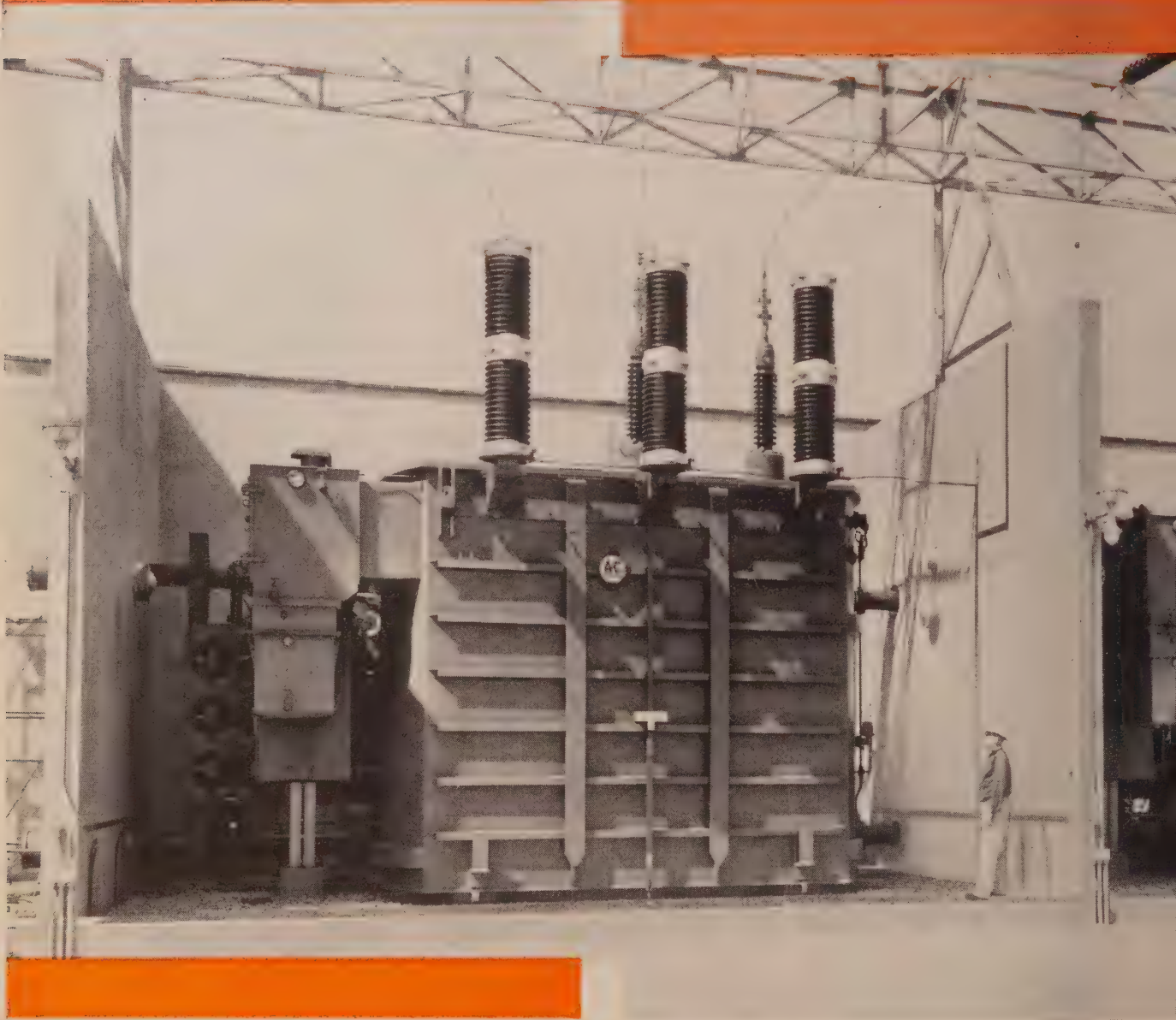
tem (total cost including losses, \$69.89) to allow for serving existing 120-v homes.

Discussion revolved heavily about how the various parameters used in the study varied from utility system to utility system. The perennial what-about-higher-secondary voltage question came up, too.

While the study concerned diversified demand per home from 1.5 to 24 kva, it was revealed that Baltimore Gas & Electric found in its studies of a 28-kva maximum demand house system, that a 240/480-v underground system (with pads and trenches supplied by the contractor) showed an eleven-percent saving over a 120/240-v overhead system. BG&E installed 51 pad mounts last year. The company ex-

(Continued on page 100)

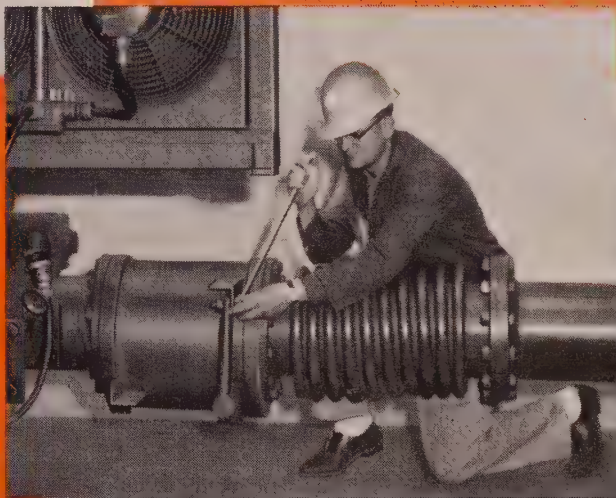
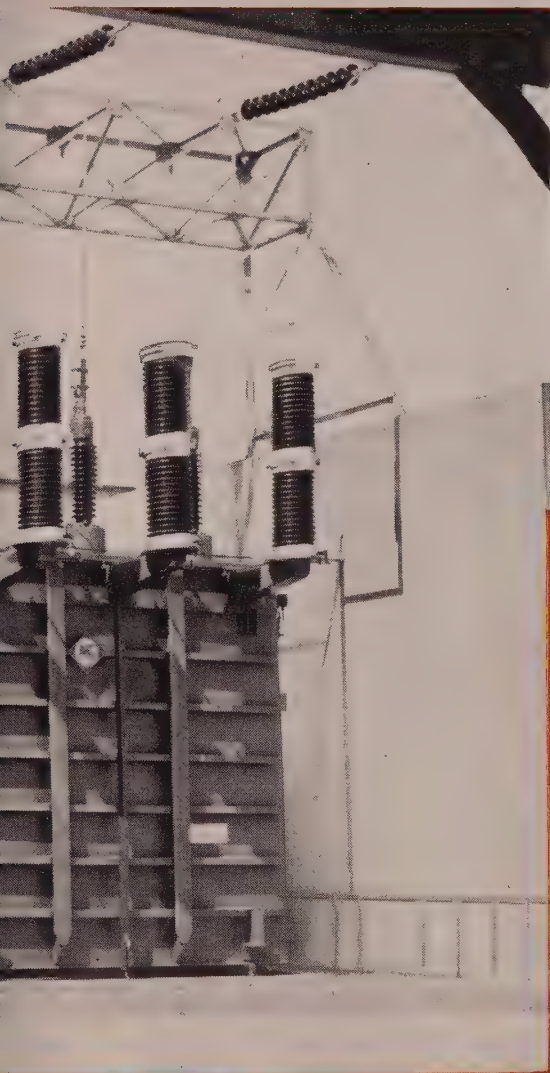
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Either of two 90-mva transformers is capable of carrying 2/3 of the combined capacity by using the "dual-cooled" feature

Wisconsin Electric Power Company counts on *designed-in* power transformer emergency capacity. Exclusive *dual-cooled* arrangement* uprates either one of the 90-mva transformers to 120 mva if the other is removed from the line.

The active transformer utilizes all of the other unit's oil-to-air cooling equipment to dissipate heat. In normal operation, each transformer uses its own coolers independently.

Stepping down 138,000 volts to 13,800 volts, the transformer bank employs accordion-type expan-

sion joints between transformers. Header pipes allow for manual cutoff. The installation has been designed to permit adding a third transformer should demand require it.

Dual cooling is but one of many A-C advantages resulting from continuing transformer research. Others include corona-free design, quiet operation, reduced size and weight, high short-circuit strength. A call to your A-C man will bring further dual-cooling power transformer details.

ALLIS-CHALMERS



POWER FOR THE FUTURE

AIEE—continued

pressed an ardent desire for a good 480-v appliance motor to fit in the new scheme. N. J. Bowmaker of BG&E said that higher secondary voltage is definitely in the picture.

Digital computers are being found just as valuable in planning distribution systems as they are in planning generating and transmission systems said R. F. Lawrence, D. N. Reys, and A. D. Patton, all of Westinghouse Electric Corporation. Method of solution for finding the most economical distribution transformer and secondary combination is to select a range of transformer ratings, secondary-conductor sizes, and numbers of connected customers and try all possible combinations of these variables. This requires that a great many cases be studied and the digital computer relieves the engineer of many tedious calculations.

The same three authors continued the discussion in other papers, saying that heretofore it has been virtually impossible to link together design factors affecting all distribution components such as secondaries, distribution transformers, primary feeders, distribution substations, subtransmission because of the rigorous formulas required have never been derived. However, the high-speed digital computer solves the problem of having to deal quickly with many alternatives while skillful programming of such a computer enables the engineer to retain many of his judgment prerogatives in setting up and evaluating the planning alternatives studied.

Higher distribution-feeder voltages are indicated under favorable conditions, a study by D. T. Michael, Cincinnati Gas & Electric, indicates. Mr. Michael concluded that with distribution capacity below 15 kv costing in the order of \$30 to \$40 per kva, service at the sub-transmission voltage of 34.5 kv becomes economical under most favorable conditions for loads as low as 300 kva, and at the sub-transmission voltage of 69 kv under the most favorable conditions for loads as low as 500 kva.

Protection

H. H. Kaufmann and J. C. Page,

both of General Electric Co. developed concepts of the nature of arcing faults in low voltage systems, as well as suggestions for protection. Where instantaneous trip devices are used, they recommended careful consideration of instantaneous settings and urged that these settings should be specified at a value lower than arcing of fault current where possible, for personal safety and prevention of equipment destruction.

A program to produce single phase fault studies by the matrix method was described by H. E. Brown and C. E. Person, both of Commonwealth Edison. This short circuit matrix approach has proved to be a valuable tool in digital calculation of fault studies. Changes can easily be made without recomputing the original matrix. High speed is maintained by storing the matrix in triangular form and reducing it at all times as much as possible, the authors said. The ability to work with submatrices while working on a faulted bus reduces internal processing time. Since both the zero sequence and positive sequence matrices are computed and retained in memory, the program can easily be extended to computation of two-phase to ground or line-to-line faults, they declared.

The digital calculation of three-phase shorts by the matrix method was described by H. E. Brown and C. E. Person, both of Commonwealth Edison; L. K. Kirchmayer, General Electric Co.; and G. W. Stagg, American Electric Power Service Corp. This new matrix approach and the computer program developed to carry out the required calculations have provided a means of obtaining three-phase fault conditions with substantial economies, as compared to previously employed analog and digital solutions. This ability to produce low-cost calculations makes possible the analysis of a larger number of system conditions. This program also forms a necessary part of future computer programs for breaker and fuse coordination studies, breaker inventory studies and relay studies, the authors concluded.

According to J. M. Clayton and F. S. Young, both of Westinghouse Electric Corp., for multi-line substations the probability of a close-in

flashover increases as the number of lines increases. When the increased probability of close-in flashovers is taken into account, arrester protection will be required in multi-line substation.

The use of neutralizing chokes in combination with neon lamp protectors provides the simplest and most effective means of avoiding the undesirable effects of differences of potential between station grounds and incoming telephone circuits regardless of how such voltages are introduced, said Oliver Ramsaur, Pennsylvania Power & Light Co. By merely disconnecting the neutralizing windings and adding the proper lamps or drain coils for the particular application, conversion of existing three-winding neutralizing transformer installations can be made easily. These methods should prove especially valuable for the protection and reliability of relay pilot circuits, which have been somewhat of a problem, Ramsaur concluded.

Insulation

Results of a study on new and reconditioned insulating oils in new and used transformers were reported in a paper by T. K. Sloat, Westinghouse Electric Corporation, and V. A. Banevicius, Cleveland Electric Illuminating. Degree of reconditioning has only limited benefit with used oils, they found, with moderately and highly reconditioned oil much poorer than new oil in either used or new transformers. Transformer oil without inhibitor performs equally as well as inhibited oil in sealed transformers, they said.

It is recognized, said T. N. Mitropoulos, R. J. Fogel, and C. J. Tang, all of Simplex Wire & Cable Company, that parameters of the shield in shielded cable have important effects on the voltages that develop in a cable system during surges, particularly those caused by lightning, which may be the reason for many unexplained failures in distribution cables. Tests are showing, they said, that shield resistance of regular-type construction at surge frequencies is extremely high while resistance of intercalated-tape construction at surge frequencies is considerably less. Similarly, both double-tape and continuous-sheath

AIEE—continued

constructions have lower resistance and lower inductance than the other construction. Low shield resistance, they concluded, reduces incoming wave fronts and improves performance of cables.

Generation:

A new method of generator excitation—harmonic excitation—has been tested by F. I. Biggs and P. I. Nippes, both of Elliott Co. Harmonic excitation originates in an auxiliary winding consisting of a seven-phase, six-pole, star-connected winding, in a 11.5-mw, three-phase, 60-cycle, 13.8-kv, 3600-rpm, air-cooled test turbine generator having 42 stator slots. Leads from this winding are brought outside the machine and fed into a full-wave bridge-type silicon rectifier from which the excitation voltage is supplied. "Plusses" include: the higher frequency power could be used to drive boiler feed pumps at higher speeds, for powering adjustable speed gas circulating fans for turbine generators, and when rectified, as a source of d-c without the need of high-voltage transformers. Efficiency of the harmonic winding is outstanding. Since it uses part of the flux already present in the air gap, it has no excitation loss chargeable to it, nor is core loss increased.

A new minimum-excitation limiter for utility generator regulating systems was described by P. O. Bobo, N. Kormanik, and H. A. Steinbruegge, all of Westinghouse Electric Corporation. Output of the limiter is polarized so that its output voltage is positive when the controlled machine is operating outside of the limit region and negative when the machine is operating within the limit region.

Tests for determining a transfer scheme on generating-station auxiliary buses were described in a paper by J. L. Barker, S. M. Hussey, and S. J. Sweeney, all of Boston Edison Company. They have found, they said, that if actual transfer time indigenous to the system, decay characteristic of the bus voltage, and maximum inrush current found with maximum available load on the auxiliaries during transfer were known that results of these tests in conjunction with manufacturer's

recommendations should tell whether or not fast transfer will stress auxiliary equipment excessively.

The ASA C-50 subcommittee on impulse testing of rotating a-c machines reported that it has arrived at the following conclusions: That impulse withstand strength of major insulation such as used in a-c rotating machines with single-turn and multiturn form-wound coils is at least 1.25 times crest of the 60-cycle ASA acceptance test voltage and that this voltage should be used as impulse strength of the stator winding ground insulation in application of surge protective equipment. That turn insulation of multiturn stator coils has a greater impulse voltage withstand margin than does the major (ground) insulation with reasonable distribution of impulse voltage. The committee concluded that acceptance impulse tests for rotating a-c machines furnish little useful information and cannot be economically justified.

Service-life expectancy of power equipment insulation (particularly

that of rotating machines) can be determined much more quickly and economically by high-frequency testing than by the usual 60-cycle test alone. R. G. Rhudy and H. E. Mazanek, both of General Electric, presented data which showed that for materials where corona damage is primarily by the erosion process, there is little reason to doubt that voltage endurance data obtained at 3000 cycles per second for about 2000 hours, accurately and reliably indicates performance at 60 cycles per second for about 100,000 hours.

Operation

Problems of operating steam-turbine generators with unbalanced armature load were discussed in a paper by R. L. Winchester, General Electric Company. Although only positive-phase-sequence voltages are generated with a machine, he said, presence of unbalanced armature currents will result in unbalanced armature terminal voltages. Losses resulting from double-frequency induced rotor currents can

(Continued on page 102)



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be very high but will generally not be a problem providing individual phase currents do not exceed allowable values based on the generator nameplate.

Potential savings through optimum use of low-first-cost peaking generation can be determined accurately and economically through use of a digital-computer procedure described in their paper, said C. D. Galloway, L. K. Kirchmayer, W. D. Marsh, and A. G. Mellor, all of General Electric Company. This computer system model can also be applied readily either directly or by modification to such problems as: value of improved efficiency of base-load steam units, value of changes in shape of heat-rate curve, system economics to be achieved by pumped-storage plants, and optimum integration of nuclear plants into a system, the authors said.

A method for making short-range peak-load predictions taking into account effects of temperatures and erratic load growth was given by W. L. Carey, Portland General Electric Company. The method is based on a statistical and mathe-

matical analysis of past load data whereby risk involved in exceeding the predicted load can be evaluated and importance of any one single peak load is not given undue importance.

A cooperative investigation of long-range system planning using the technique of simulation or operational gaming has been made, said C. J. Baldwin and C. A. DeSalvo of Westinghouse Electric Corporation and C. H. Hoffman and E. C. Plant of Public Service Electric and Gas, resulting in a combination of mathematical models within the memory of a digital computer which can simulate 20 future years of daily experience of a power system in about 20 minutes. Operation of this model as it responds to load growth and statistically predictable or to random events provides guidance in planning obtainable in no other way, the authors stated.

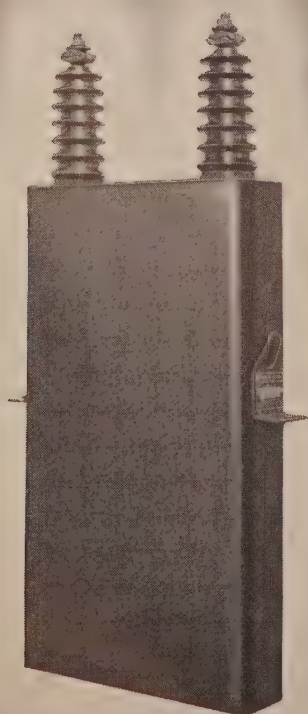
One part of the long-range system planning model just described, said C. J. Baldwin and D. P. Gaver, Westinghouse Electric Corporation, and C. H. Hoffman and J. A. Rose, Public Service Electric and Gas is

the use of simulated reserve margins to determine generator installation dates. Generation by operational gaming of many possible sequences of events within statistical probability established by history produces a measure of average performance and dispersion by which to compare daily available generation with peak load. Required installation date for a new unit is really a random quantity with certain statistical properties, they said, and dispersion of margin as caused by load and capacity fluctuations is an important factor in evaluating real risk.

A new digital-computer method for direct calculation of loss-formula coefficients offers significant improvements over previous methods with respect to costs, accuracy, and data handling, said L. K. Kirchmayer and H. H. Happ of General Electric Company and G. W. Stagg, and J. F. Hohenstein of American Electric Power Service Corporation. The method determines directly impedances between sources and the hypothetical system load and projects these impedances to loss-

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"COMPACT ISOKRAFT 50" Capacitors now weigh only 82 pounds—the smallest, lightest 50-kvar units on the market today. The 17 percent weight reduction and 20 percent volume reduction from the General Electric "ISOKRAFT 50" unit introduced in 1959, mean faster, easier installation of individual units or equipments. And reduced installation time means lower installation cost.

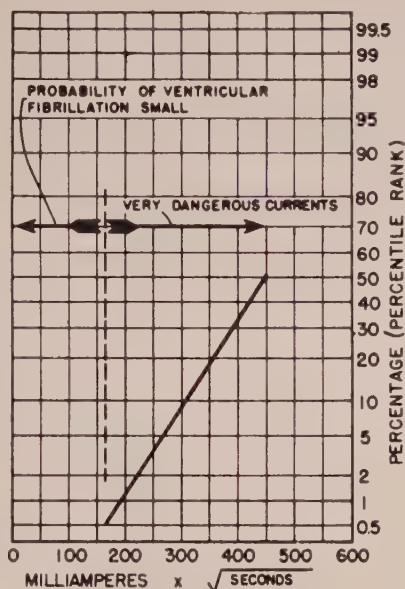
One lineman can bring the new "COMPACT ISOKRAFT 50" capacitor to the base of a pole while his partners make other preparations for installing the unit in a hanger or in an existing pole-type equipment. Hand holes in the unit carton facilitate easy handling of boxed units in warehouses and in transit to the installation.

formula coefficients in a manner similar to that used previously. Rectifying characteristics of the sources are calculated automatically. In addition, the authors said, the computer determines from peak and off-peak load data the loads requiring special treatment, and automatically computes linear and constant-loss formula terms which represent constant components of these loads.

The application principles and all testing subsequent to design testing, necessary to check both the design and application of new transistorized phase-comparison relays under actual system conditions were described by S. H. Horowitz, American Electric Power Service Corp.; and A. J. McConnell and H. T. Seeley, both of General Electric Co. Performance of this new relay was excellent and no design changes of its basic circuits were required. A study of the test results suggested changes in application practices and relay settings to cover more severe fault conditions.

In describing the trends in undergraduate electrical engineering curricula, M. L. Manning, South

Dakota State College, said that there is a trend to require more than four years for graduation from



an engineering curriculum.

Study of minimum currents that can cause ventricular fibrillation in the heart, and hence very probable death, has been made by Charles F. Dalziel, University of California, with results reported in his paper. Extension of data found from ex-

periments with animals gives conclusions for men as shown in the accompanying chart. Currents to the left of the $\frac{1}{2}$ -percent line in the chart, concluded Prof. Dalziel, although possibly resulting in a very severe shock, should have small probability of causing ventricular fibrillation while current values to the right become progressively dangerous with increasing probability that ventricular fibrillation will occur with death a likely result.

At the present time defibrillation through means of a second electric shock has been practiced most successfully at The Johns Hopkins University hospital where this equipment has never failed to arrest a ventricular fibrillating heart, reported W. B. Kouwenhoven, G. G. Knickerbocker, W. R. Milnor, and J. R. Jude, all of The Johns Hopkins University. Until such time as a defibrillator becomes available for field use and can be brought into actual operation, the authors suggested that the technique of closed-chest heart massage be used in conjunction with artificial respiration.

INSTALLATION

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Leading manufacturer of electrical apparatus, Mid-West location, has the following challenging opportunities for competent and ambitious engineers:

A. Quality Control Engineer—Experienced in electrical tests of electrical apparatus including oil filled transformers up to 500 KVA. To take charge of all electrical and mechanical testing, quality control laboratory, and statistical analysis of production line testing.

B. Standards and Methods Engineer—To establish and maintain engineering standards in a rapidly expanding manufacturing operation. Experience in oil-filled distribution transformers desirable.

Excellent future. Salary open and commensurate with experience. Our employees know of these job openings. Address Box 3154, **ELECTRIC LIGHT & POWER**, 6 No. Michigan Ave., Chicago 2, Illinois.

FIELD SALES ENGINEERS

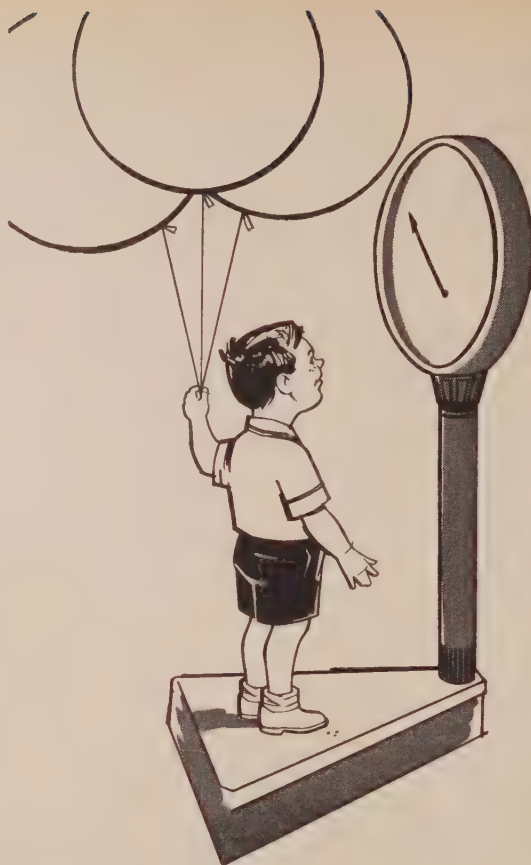
Manufacturer of electrical transmission and distribution equipment has opportunities in New England for field engineers.

Primary duty is promotion of company's products to electric utility industry. Travel requirements arranged so as not to interfere with full family life. Automobile is provided and maintained by company.

Utility company experience is not a requirement, but electric power industry background is desirable. Company philosophy stresses advanced personnel policies.

Compensation includes salary, profit sharing bonus and trust plans.

T. C. Hughes,
Sales Service Manager,
Line Material Industries
700 West Michigan Street
Milwaukee 1, Wisconsin



don't let
the numbers
fool you

The hi-pot rating of a photoelectric streetlight control (the maximum *sustained** voltage it can take between its electrical and mechanical connections without breakdown) is important. If the hi-pot isn't high enough, the control may be an unexpected weak link in the system, behaving like a fuse instead of a switch.

Naturally the hi-pot rating of a control should be qualified by a description of the test method used. When a high, stiff voltage is applied to the control and "ground", the test is honest—but dangerous. A common practice is to insert a current-limiting resistor (on the order of 10 megohms) to take care of the danger—but then even a little leakage in the control will cause a big drop in the applied voltage,

with the result that the hi-pot rating is falsely high. The voltage at the control is substantially less than the applied voltage as read on the meter, just as the indicated weight of the buoyed-up boy in the picture is less than his actual weight.

To get a "true" hi-pot rating, we eliminate the resistor and carry out the test in an insulated box which provides the necessary protection. Thus the voltage read on the meter is the same as that across the control. The new F-P bakelite-chassis 6600A controls will withstand a hi-pot test of at least 9 KV—honest. The Fisher-Pierce Co., 81 Pearl Street, So. Braintree 85, Massachusetts.

*as contrasted to "flash-over" effects caused by extremely brief, high voltage peaks.


FISHER PIERCE
PHOTOELECTRIC LIGHTING CONTROLS

AN AFFILIATE OF SIGMA INSTRUMENTS, INC.

Equipment Manufacturers Debate Anti-Collusion Policies as

Indictments Jog Industry, Bring Marketing Changes

What marketing moves could be expected from electrical manufacturers involved in the recent Federal indictments charging anti-trust law violations? How have they responded to "the prayers for relief" against the alleged practices, sought in civil suits also filed by the Department of Justice?

Initially, the principal actions or reactions were these:

1. Acceptance of guilt, imputed by the indictments and civil suits, though on a tentative basis (and subject to further actions in court), by at least the management of GE, Westinghouse and Allis-Chalmers;

2. Reiteration of company policies forbidding practices of the type described in the indictments, plus

declaration of intent to strengthen the company policing of marketing procedures such as those under investigation;

3. Reported development, in recent weeks, of market conditions wherein "more competitive" price terms and bid actions contrasted with earlier situations presumed to have been affected by practices in violation of anti-trust laws.

Top management of the accused companies, obviously was hurt and angry. In their statements, for example, were such phrases as: "the gravity we attach to the situation," . . . "came as a shock" . . . "we are distressed."

While denouncing the alleged practices of their sales representa-

tives and denying knowledge of their existence, legally, top management would have to share the blame, at least in the name of the corporation. And, it was a good question whether customers would accept the proposition that the accused individuals rather than the higher echelons of management had alone committed whatever illegal acts had been performed.

Utility customers, as might be expected, expressed disapproval of the alleged violations in terms that were violent, in some cases. Purchasing officials, particularly, found cause for optimism about their bargaining positions opposite the suppliers who would now lean over

(Continued on next page)

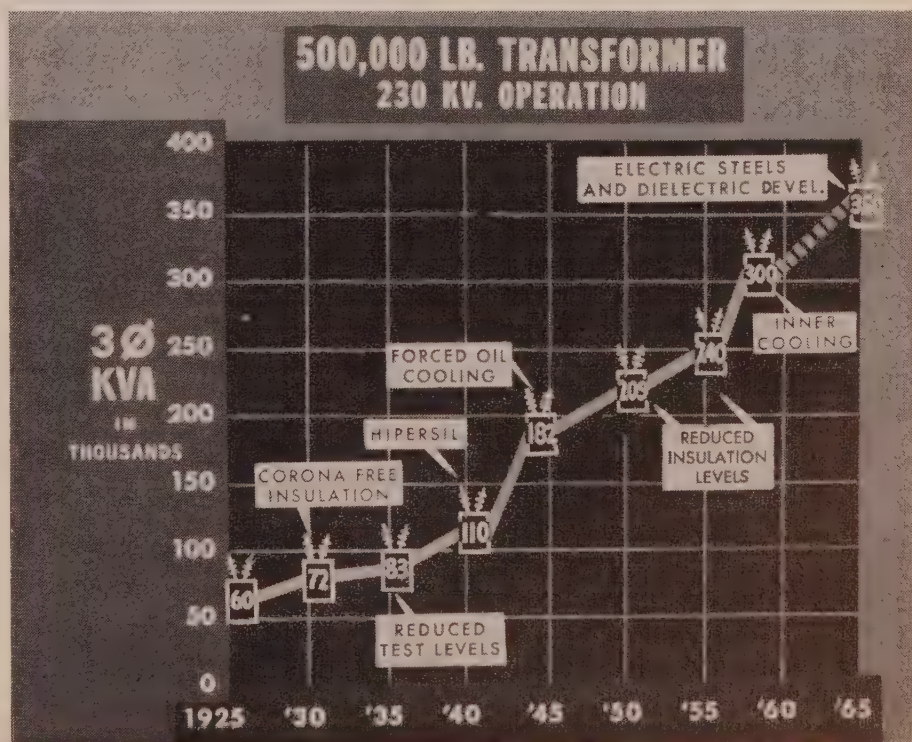
Mills Tells P.A.'s: Profit From Hidden Values

The *hidden values* to look for when spending utility dollars are numerous, C. W. Mills, Westinghouse electric utility sales dept. manager, reminded purchasing executives with the NAPA Public Utility Buyers Group last month.

Most important, of course, is the product itself . . . "the fact that it has been pre-tested for reliability in service, so that your system isn't converted into a trial-and-error laboratory with consequent outages and the expanse they entail," he conceded. And, he said, there are other *hidden values*: (1) The service backup on equipment, (2) engineering services (for which no charge is made), (3) nationwide warehousing facilities, (4) training services and advanced study seminars of all sorts which are available to your professional people.

Then, there are those *hidden values* that come from continuing research and product development, "a

(Continued on page 106)



DEVELOPMENT has produced 500,000 lb. transformers which will probably go to 350,000 kva. Costwise, operating efficiencies have absorbed the higher cost of today's units and has given a 26¢ per kva bonus.

backwards to avoid any semblance of improper marketing practice.

But, recently as February, in their NAPA Public Utility Buyers' Conference (see EL&P, Mar. 1, page 47), leading purchasing executives had acknowledged certain facts of market life in this economy: (a) price uniformity is part of a long-term trend; (b) in spite of intense competition, prices will continue to inch up in the coming year. So, what they might expect in the way of any marketing changes resulting from the recent Federal grand jury indictments could hardly be of a revolutionary nature.

However, the Justice Department's civil suits specifically required the manufacturers to: (a) issue new price lists . . . based upon costs independently arrived at; (b) to submit affidavits of non-collusion with future bids to governmental agencies; and (c) to prevent any communications among the defendants with respect to future bids and price quotations.

On the part of buyers of electrical equipment, it is customary to require competitive bidders to furnish affidavits of non-collusion, though undoubtedly the use of this requirement may now be expected to be more widespread.

In its newly stated policy in these anti-trust areas, Allis-Chalmers dealt most specifically with the conditions covered in the civil suit relief requirements. "Under the circumstances," observed A-C Pres. R. S. Stevenson, "we believe special attention is necessary," as follows:

"No employee of the Company shall agree with any competitor or group of competitors, or advocate or suggest to a competitor the desirability of an agreement, in any line of products of the Company (except in connection with the proposed sale of a product by the Company to a competitor or vice versa), with respect to (a) prices, discounts, commissions, or other terms and conditions of sale; (b) production quotas; (c) allocation of markets or specific customers; (d) methods or channels of distribution; or (e) any other matter concerning the production or sale of products which would tend toward the establishment or maintenance of fixed prices, limited production, or restricted markets.

"More specifically, no employee of the Company shall:

1. Attend any meeting at which any of the above matters are treated, except regularly scheduled trade association meetings wherein purely historical information of a general or statistical nature concerning said matters may be disseminated, but future plans or policies concerning them are not disclosed or discussed.

2. Correspond, or discuss orally, with a competitor the desirability of establishing or adhering to specific prices or price levels, terms and conditions of sale, discount schedules, trade classifications, quotas, or markets.

3. Furnish a competitor, or accept from a competitor, either directly or through an intermediary, any information concerning the establishment or changing of prices, discounts or trade classifications, or terms and conditions of sale, in advance of publication of such information to the trade generally."

Promised Mr. Stevenson: "We have already undertaken a thorough program which will continuously present this policy to those individuals in our entire organization whose duties might require it, and which will thoroughly educate them in the specific areas in which this and all of the other Antitrust laws apply.

"We will dedicate ourselves to the end that the present situation will never arise again."

Westinghouse, too, pledged that it will require "strict adherence on the part of all employees to all anti-trust, marketing and trade regulation laws, and to the tenets of good business ethics." As phrased by Westinghouse Vice-President Dale McFeatters, the statement further promised that the Westinghouse "policy will be administered with renewed determination and vigor."

Why did the violations take place? What, if any, explanation could be given for the practices alleged to have occurred? The Allis-Chalmers chief executive viewed it this way: "If any of these men be found guilty, their acts could not have been flagrant or defiant, but in a completely mistaken effort to serve their employer, without assurance or hope of personal gain."

And, the Westinghouse spokes-

man pointed to the unique situation where—though it might be expected that sales in the product areas under investigation would have been characterized by rising prices as a result of the alleged illegal practices—"the fact is, in face of an average increase of almost 10-percent in labor and material costs during 1958 and 1959, the average selling prices for our equipment (switchgear) have actually declined."

Declared Mr. McFeatters: "The existence of any such action as charged in the indictments certainly did not react to the benefit of the company . . . or against the interests of customers and the public."

Within one week after the indictments were announced, only one company completely denied the charges. Judson Large, vice president and secretary of McGraw-Edison Co. said, "The sale of electrical equipment to public utility companies is one of the most competitive in our national economy." He went on to say that while the company could not expect to obtain higher prices than those established by the larger manufacturers, McGraw-Edison likes to get "as good a price as the big boys charge."

(Continued on page 109)

L-M Awards Transformer



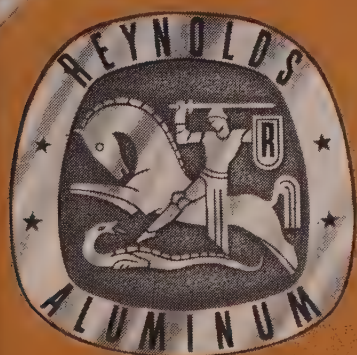
A 50-KVA TRANSFORMER and a \$500 employee benefit fund gift were awarded to Hart Hydro-Electric for operating the oldest Line Material transformer. The award was made as part of the L-M Silver Anniversary celebration. The oldest transformer, the twenty-first ever manufactured by Line Material, has been in almost continuous use since installation. V. Lambrix, line distribution superintendent (r.), receives the award from A. R. Waehner, L-M director of transformer product sales (l.) while J. L. Barger, L-M field engineer, and H. Gwinnup, Hart, Mich., city manager, look on.

EASY TO SPlice



REYNOLDS 5005

high strength, all-aluminum conductor



No steel core makes splicing easier with standard connectors and tools—perfect for "hot line" maintenance. All-aluminum conductor also eliminates chance of galvanic corrosion. Light weight lowers installation costs—it's easier to string, easier to handle. And Reynolds 5005 costs less than any other conductor with comparable properties. Minimum guaranteed conductivity 53.5%. Complete data available from your nearest Reynolds branch office, Reynolds Electrical Distributor, or Reynolds Metals Company, P.O. Box 2346-EJ, Richmond 18, Virginia.

Watch Reynolds TV shows—"ALL STAR GOLF", "BOURBON STREET BEAT" and "ADVENTURES IN PARADISE"—ABC-TV

IT'S *the decision* THAT COUNTS



...with a fuel, too!

B&O bituminous merits your winning decision for sensible plant operating reasons. (1) Volume supply in wide variety is a sure bet to outlast current competitive fuels. (2) Sources are nearest to major consumption—always dependable. (3) Mining and burning developments continually tailor bituminous to greater efficiency. Bet on B&O Bituminous! **Ask our man!**

CONSULT COAL TRAFFIC DEPARTMENT, B & O RAILROAD
BALTIMORE 1, MD. Phone: LExington 9-0400



ECONOMICAL FOOTINGS . . .

(Continued from page 83)

averaging the bids of four typical bidders and adding these labor costs to the actual material costs. Also, as stated in the figures, the curves are based on a 30° "cone" of uplift soil. Different values of "cone" will change the slope of the curve slightly, but will not alter the overall relationship.

From these curves it can be seen that when uplift is the governing condition, as it usually is, a deeper footing with certain limitations is usually more economical. This relationship is due to the fact that in using the "cone" concept for determining resistance to uplift the volume of this "cone" varies with the cube of the depth.

It was this premise that prompted the design of the grillage using varying-length connections.

It should be pointed out that these curves cover uplift only. If bearing is the governing factor, increasing the depth will not be of any help, except where the deeper footing places the load on a different strata of earth.

Summary

An economical footing design consists of two parts: (1) adequate and proper preparation and (2) intelligent investigation and design.

The preparation begins in realizing that the economical footing does not have its start on the drafting table when actual footing is being designed. It had its start months previously at the time the line was being located and the tower loads were being determined. The factors mentioned herein when given sufficient thought will produce an economical and safe design.

References

1. Steel Towers for Extra-High Voltage System, Bonneville Power Administration by Forest W. Farr, AIEE Paper No. 59-106
2. Soil Mechanics in Engineering Practice—Terzaghi and Peck
3. Foundation Engineering—Peck, Hanson & Thornburn
4. Sub-Soil Investigations for Foundations, Raymond Concrete Pile Company.
5. Transmission Line Tower Footing Design by L. B. LeVesconte, W. C. Freeman and R. L. Reese, AIEE Paper No. 57-1082.

RCA System Integrates Branch Operations

An "electronic pipeline for paperwork" has been developed by Radio Corporation of America which will bring the operations of distant branch offices into the company headquarters as integral parts.

The system—which is known as DaSpan (for data-span) uses normal telephone or teletypewriter lines and enables an outlying office to feed directly to headquarters computer systems all types of business data for processing. Transmission is almost instantaneous and has been found to be economical. Processed information can be returned to the branch office via the same lines.

In effect, the new system will make an office in Patterson or Peoria an integral part of the headquarters operation and make data reduction and processing as available to them as to any department located within the headquarters building.

When a branch office has paperwork to pass along to the home of-

fice computer center, a perforated tape is prepared on a typewriter-like device which may also turn out a printed copy of the material being submitted.

In standard teletypewriter transmissions, there are five rows or levels extending the length of the tape on which hole may be punched. The vertical arrangement of holes on the tape determines the letter or character to be relayed.

The RCA DaSpan tapes employ a seven-level code, which permits the tape to be fed directly into an RCA 501 computer with no intermediate steps. Provision is also made for tapes employing five-, six-, or eight-level codes. However, in such cases, the tape must be fed through a convertor which turns out seven-level tape the computer will accept.

At the sending end of the line the prepared tape is run through a DaSpan transmit-receive unit, through a subset to convert the data to telephone system "language" and then onto the wire.

At the receiving end the information is passed through another sub-

set and a similar transmit-receive unit which turns out the seven-level code tape the computer will accept.

After the computer has processed the data, the information is re-converted to a perforated tape and relayed back to the branch office through the same devices described above. At the other end of the wire a copy tape is produced, which, when fed through a reader, translates the tape to a printed report.

RCA has announced two types of unit—one that handles seven characters per second and a high speed unit that handles 100 characters a second.

"This represents a long-sought step forward in electronic data processing," according to Donald H. Kunsman, vp and general manager of the RCA EDP division. "DaSpan provides truly integrated data automation, even when coast-to-coast distances separate the computer location from the warehouse, factory or sales office. Because telephone lines are employed, on a toll-call or lease basis, DaSpan can serve all of a company's automation and EDP needs at high speed and with great economy. Where communications of slower speeds will suffice, DaSpan can also be supplied for use on telegraph lines. Whether by telephone or telegraph, the system has the built-in accuracy control features necessary to accurate, high speed data processing."

MILLS TELLS . . .

(Continued from page 108)

major reason you have been able to sell your product—electrical energy—at a lower cost today than you could in 1935," said Mr. Mills.

Mr. Mills cited a number of examples of hidden values that come from continuing research and product development. For example, the purchase of a 250-megawatt turbine generator unit today—compared with a unit a manufacturer could have supplied using the technology of 1935—results in a saving of 40.6-millions of dollars, in fuel costs alone. Further illustrating the value of research over the past 25 years, said Mr. Mills, you could add the extra cost of land and structure for housing four machines (which would be required) rather than the one, the cost of station auxiliaries,

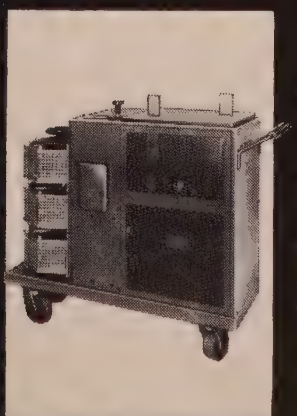
(Continued on page 114)



IMPULSE TESTED

TRANSFORMERS

Eisler has built transformers of all types for 38 years, and there's a complete range available up to 500 KVA. Our engineering staff will welcome the opportunity of working with you on your standard and special requirements.



DRY TYPE and LIQUID FILLED • STANDARD and SPECIALS

EISLER TRANSFORMER COMPANY, INC.

Division of Eisler Engineering Co., Inc.

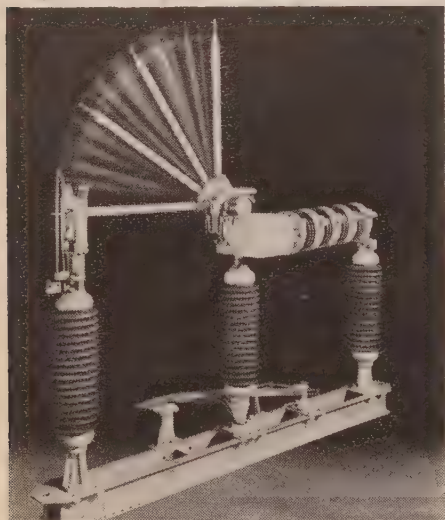
20 NORTH SALEM STREET, DOVER, NEW JERSEY

NEW PRODUCT

DESIGN



High Voltage Switch Device



Developed for high voltage switching, Circuit-Switcher has

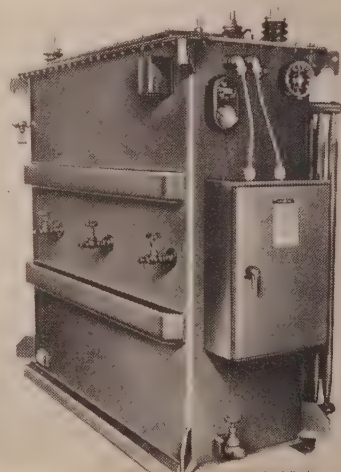
been introduced by **S&C Electric Co.** for 34.5 to 138 kv use. Resembling a load interrupter switch in appearance, but working more like a circuit breaker, Circuit-Switcher is a generic name for a whole family of switchgear for handling a number of circuit interrupting functions. The device mounts like a load interrupter, it is opened and closed like a load interrupter and it isolates circuits visibly with air like a load interrupter. However, like a circuit breaker, the device, carries current continuously through its interrupting unit. Trips from stored current, but the energy is self stored. The Circuit-Switcher has positive sequence control built in.

Circle item #23 on reply card

Feeder-Voltage Regulator

Completely automatic and self-contained low cost, feeder-voltage regulators (type SVR-FT) are available from **Westinghouse Electric Co.** The 60 cycle, three-phase, step-type regulators are rated 500 and 750 kva for 8.66 or 13.2-kv circuits. The units feature 16 step voltage regulation over a 20 per cent range, resulting in fewer operations, extension of contact life, decrease in average error, and an increase in quality of regulation.

Circle item #24 on reply card



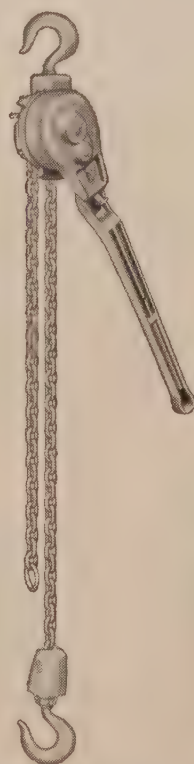
AGAIN . . . Coffing Brings You a New Line of Hoists

The new Safety Pull Aluminum Ratchet and Pawl Lever Hoist is easy to operate—requires minimum handle pull. It may be operated from either side, and the design prevents freezing a load.

Safety has been built into the hoist. It will not ratchet under load if handle is released nor will it free chain. Controls are protected from inadvertent shifting. The bottom stop eliminates any hazard from the handle being released unintentionally. The exclusive safety handle bends to indicate overload.

Strength without excess weight in the new hoist is achieved by a special aluminum alloy which is used in the body and handle.

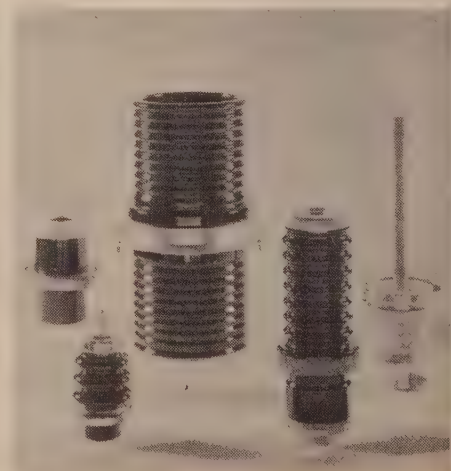
Available in six models with capacities from $\frac{3}{4}$ to 6 tons. Ask your distributor or write for Bulletin ADH-86.



Solder-Seal Bushings

Solder-seal bushings designed for low voltage applications on hermetically sealed capacitors, test transformers, and other equipment have been announced by **Lapp Insulator Co., Inc.** Completely leak-proof, the bushings have high mechanical and dielectric strength and can be designed in a choice of shapes, sizes and ratings to fit a wide range of applications. Used with soft solder method.

Circle item #25 on reply card



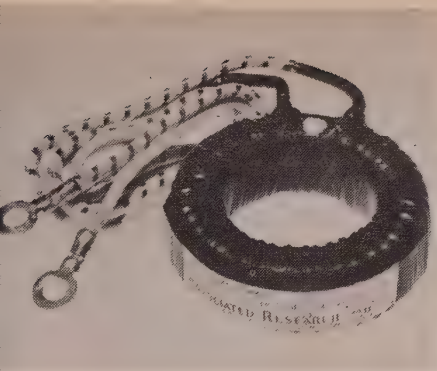
COFFING HOISTS



DUFF-NORTON COMPANY

807 Walter Street

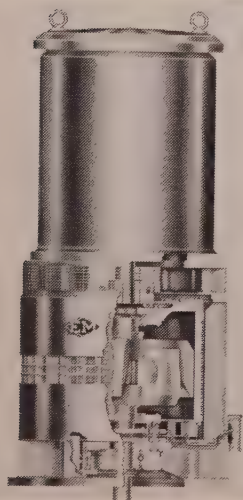
Danville, Illinois



Current Transformer Line

Series 700 "Donut" Current Transformer for metering and allied applications is available from **Associated Research**. Used for extending the range of ammeters as well as to provide operating currents for re-lays. The Series 700 Current Transformers are available in ratios from 10/5 to 5000/5 with burden ratings of 2.5 to 12.5 kv. Complete specifications are available in bulletin 3-1.2 from the manufacturer.

Circle item #26 on reply card



Vertical Magnetic Drive

Electric Machinery Mfg. Co. has developed a vertical magnetic drive especially for pump drive application. Manufactured in five sizes, the Ampli-Speed can provide pumping speeds over a range from 0-1740 rpm. A variety of sensing controls can be used to make pump operation automatic (speed is constant within ± 2 per cent). Ampli-Speed is air cooled and drive controls are transistorized.

Circle item #27 on reply card

STERLING

Field Proven!! HEAVY DUTY DIGGING...



FOR
TRANSMISSION-
DISTRIBUTION
CONSTRUCTION

TOWER
FOUNDATION
DIGGING

34'
TELESCOPIC
POLESETTER

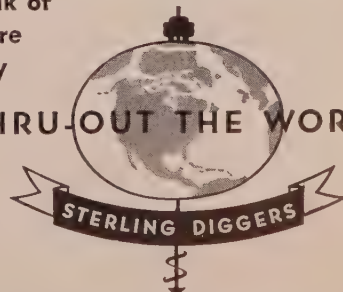
Cuts Costs Cuts Job Delays

Now **STERLING DIGGERS**, noted for ruggedness, dependability and ease of operations, introduce their field proven, **HEAVY DUTY MODEL**.

Specifications include 3" Bar; Ford Industrial Engine; 34' Telescopic Pole Setter; 10,000 lb. Hydraulic Winch; Hydraulic Outriggers; completely integrated bank of Hydraulic Controls; Turntable, Fore and Aft Mounting on heavy duty truck.

Ideal for Transmission Construction Under Extreme Conditions.

THRU-OUT THE WORLD



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STERLING ENGINEERING & MFG. CO.

Wilkes-Barre, Pa.

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Five **STERLING MODELS** For Every Purse and Purpose
Nationwide Sales and Service

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the Modern Trend in STREET and HIGHWAY LIGHTING



TOP PHOTO: New White Way—White Plains, New York

LOWER PHOTO: Traffic circle illumination—West Miami Springs, Florida

P&K ALL ALUMINUM LIGHTING STANDARDS & DAVITS

More than just modern-looking, P&K street lighting standards are modern in total concept. Compare our use of functional design... no scrolls, no tie rods... instead a strong aluminum tapered elliptical arm—one piece for minimum inventory, fastest assembly and installation. Compare the P&K davit, truly the ultimate in functional design with a style as fresh as tomorrow. What's more, P&K is modern in the materials of construction: to the inherent strength and light weight of aluminum, P&K has engineered designs to meet every load requirement—from the conventional incandescent and mercury vapor luminaires to the new, larger and heavier models in both mercury vapor and fluorescent. And above all, P&K is modern in its elimination of maintenance problems. No painting required—ever. Even the salty sea air offers no hazard to the good looks of P&K standards.

For more information reserve your copy of the new Aluminum Lighting Standards catalog now. Ask for our helpful brochures ALS and BR-11.

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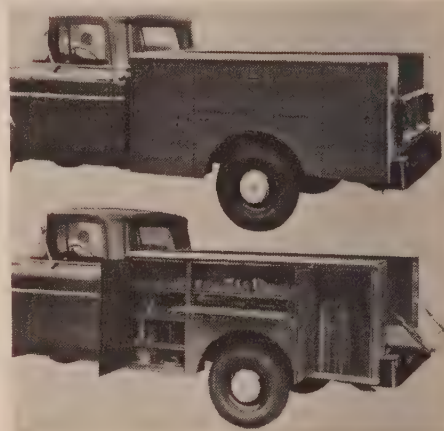
PFAFF & KENDALL 84 FOUNDRY ST., NEWARK 5, N. J.

BRANCH SALES OFFICES: MIAMI, FLORIDA; BURLINGAME, CALIFORNIA
IN CANADA: POWERLITE DEVICES, LTD., TORONTO, MONTREAL, VANCOUVER
EXPORT REPRESENTATIVE: PHILIPS EXPORT CO., NEW YORK, N. Y.

Job-Planned Utility Bodies

Reading Body Works, Inc. has introduced a line of utility truck bodies, redesigned for 1960 Ford chassis. The center of gravity has been lowered two inches, giving a smoother ride and greater stability. The lower body also gives unobstructed vision through the rear window. Special features of the line are the adjustable and removeable dividers and removeable shelves in weathertight storage compartments.

Circle item #28 on reply card

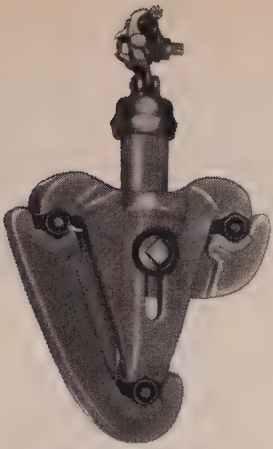


Noise Reducing Bushing

A stress relieving ground sleeve, usually found only on power transformer bushings, eliminates the usual concentration of stresses that could cause radio noise in the Kuhlman Quick Grip Bushing. Also features full-protection hand grip, allowing line connection without tools; heavier, stronger skirts; internal clamping which eliminates external hardware; and a spring loaded terminal accommodating a wider range of aluminum and copper conductors.

Circle item #29 on reply card

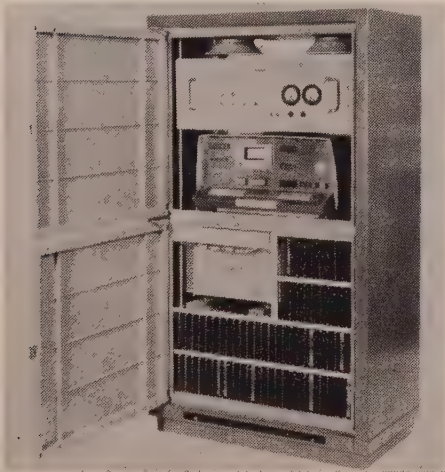




Aerial Cable Spreader

Six inch on-center-spacing of the conductor makes the **Fargo Mfg. Co. S-1 Aerial Cable Spreader** ideal for 5- or 15-kv installations. It is mechanically capable of withstanding forces in excess of 10,000 amperes fault current and will support minimum dead weight loads of 1500 lbs. Design eliminates need for grommets and provides a range over insulation from 1/2 in. to 1 1/2 in.

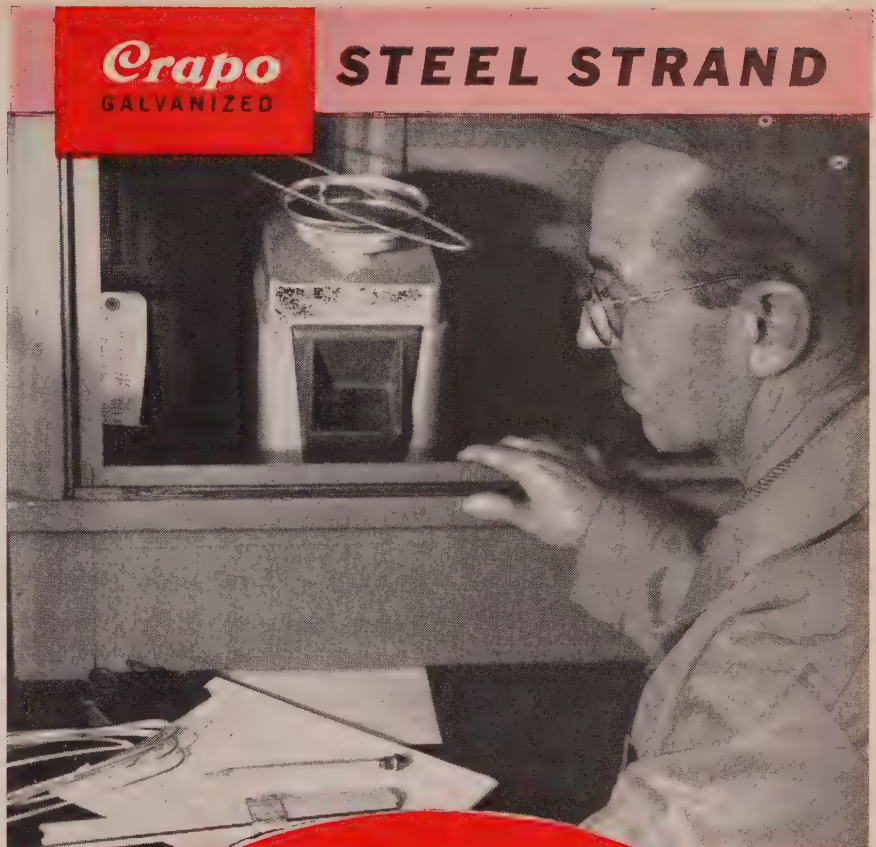
Circle item #30 on reply card



Process Control Computer

The fully transistorized LN-3000 digital computer is described as *part* of a system for process control. Said to be one of the smallest computers available, the LN-3000 with its associated input-output apparatus occupies about the same space as a pair of four-drawer filing cabinets. Designed for three general on-line functions: open loop control for on-line data reduction and calculation of operating guides, program control, and supervisory computer control. From **Leeds & Northrup Co.**

Circle item #31 on reply card



WEIGHT OF COATING TEST

...added assurance of dependability



The life of galvanized steel strand depends primarily upon the weight and quality of the zinc coating. The heavier the coating the longer the strand will last.

The wire used in CRAPO Galvanized Steel Strand is regularly subjected to the hydrochloric acid antimony chloride, or weight of coating, test. By means of this test the amount of zinc on the surface of the wire can be accurately measured.

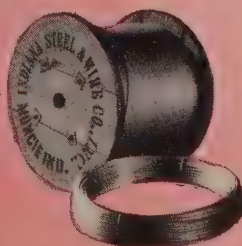
This is but one of the many laboratory tests to assure consistently high, dependable quality in the finished product.

AVAILABLE IN 3 COATING WEIGHTS

CRAPO Steel Strand is regularly furnished in all standard sizes and grades and in Class A, B and C coatings. Class B coating is twice as heavy as Class A coating; Class C coating is three times as heavy.

Write for this FREE BOOKLET!

"The Story Behind CRAPO Galvanized Wire and Strand" describes and illustrates manufacturing and testing techniques. Ask for Booklet B-59!



STEEL & WIRE CO., INC.
Muncie, Indiana

(Continued from page 109)

switchgear, transformers, and so on for four machines . . . " and the total savings realized through the improved efficiency of the new machine becomes staggering."

Turning to the field of distribution apparatus, the Westinghouse representative remarked: "We've been inclined to overlook some of the things that have happened here over the past several years, because of the kind of spectacular progress (achieved) in generation. But, after all, distribution apparatus accounts for from 30 to 40-percent of utility capital investment."

So, this example was cited by Mr. Mills: A 500-kva pole-mounted distribution transformer that "replaces the pad-mounted unit." The weight has been reduced 20-per cent, losses are reduced, and the price is 20-per cent less—"to say nothing of the savings resulting from elimination of the pad-mounting and related

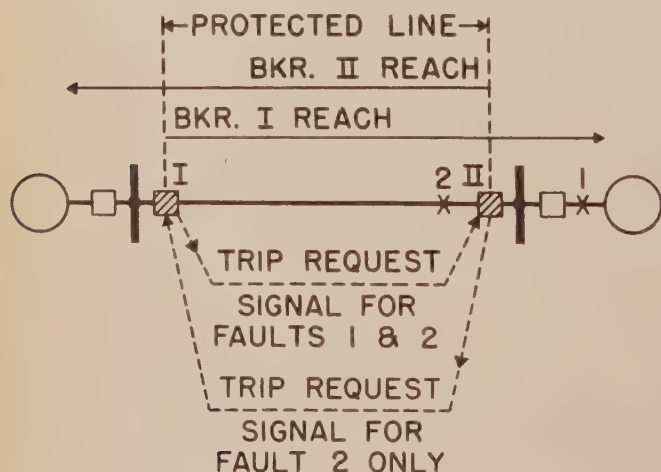
gear."

And, said Mr. Mills, here's the story of what happened to 500,000-pounds of transformer: "In 1925, we could pack 60,000-kva into a half-million pounds. Then, through such developments as corona free insulation, reduced test levels, Hipersil core material, forced oil cooling . . . and now vapor cooling we can cram 300,000-kva into that same half-a-million pounds. We are perfectly confident that this will rise to 350,000-kva in the near future. As for the cost . . . well, in 1925, a large single phase transformer cost \$1.26 per kva. *Today's* large three-phase unit costs \$1.74 . . . that's only a 38-per cent increase in 29 years. However, technical advances over the same period of time have resulted in operating efficiencies that save \$2.00 per kva. That completely absorbs the cost of today's units and gives you a 26-cent bonus."

K-Dar Compensator Relaying For New Trip System

K-Dar compensator relays for directional-distance relaying on transmission circuits are now used by the Westinghouse Electric Corporation in a new K-Dar directional

the blocking or transfer-trip systems. High-speed simultaneous clearing of all types of line faults was also effected with the new trip system.

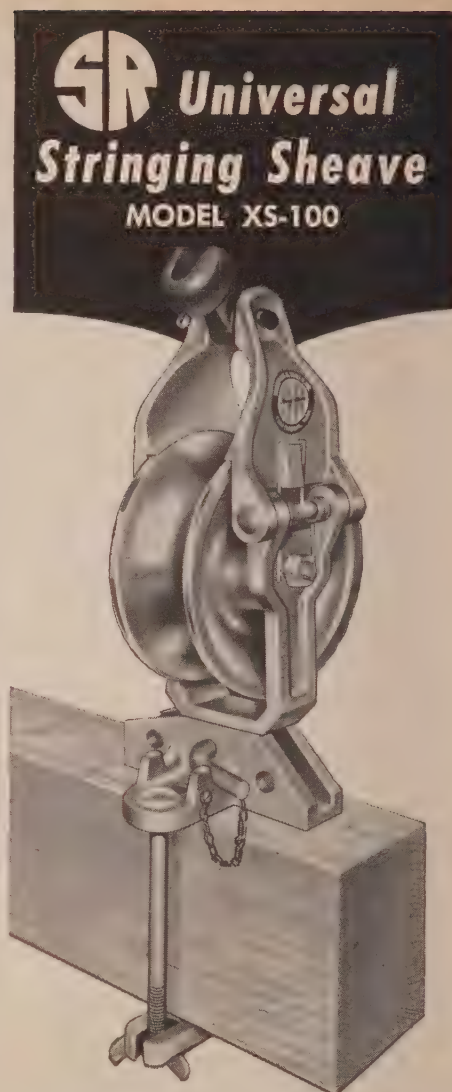


Directional trip system showing fault detection zones of the directional high-speed tripping relays.

comparison trip system for protective relaying with microwave channels.

In the development of the new K-Dar microwave trip scheme, the best features of existing blocking and transfer-trip systems have been incorporated. This has resulted in faster and more complete protection than is available with either

In the K-Dar system, a trip request is transmitted by a terminal in the direction in which it "sees" a fault. Hence, the terminals on each side of a line will send trip requests to each other, thereby answering the other's trip request so that breaker trip circuits are energized at each terminal to clear the fault.



- USE** on CROSSARM as shown
- USE** on ANGLE for cornering block
- USE** without BRACKET to suspend from insulator stringing

Light weight, adjustable bracket, tough aluminum alloy throughout, safety locking, wide throat and anti-friction bearings. Grooved for cable through 1 3/4" diameter. Designed especially for ACSR.



NEW CATALOG

on complete line of S&R Conductor Stringing Equipment sent on request.

SHERMAN & REILLY, INC.
ENGINEERS AND MANUFACTURERS
CHATTANOOGA 2, TENNESSEE
Telephone AMherst 7-1273
TWX CT-7036



Expand Simplex Test Laboratory

Simplex Wire and Cable Co. is expanding its high voltage cable test facilities by the installation of a one-half million volt cable test set from General Electric Co.

The new test equipment, rate 500 kv d-c, 25 ma, will be installed in Simplex new testing facility at Cambridge, Mass.

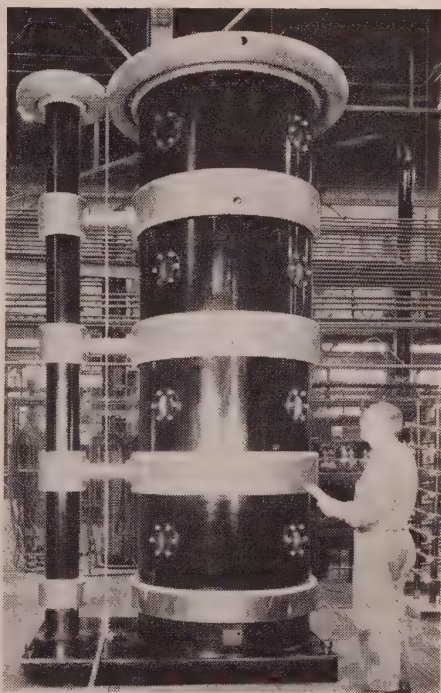
When combined with an existing test set, the new equipment will increase the test set rating to one million volts d-c, and will form the base units of the complete test set up which will consist of eight 125 kv d-c units cascaded to a height of 25 feet.

The new set will consist of a main rectifier stack and resistance voltage divider, a control bench and a voltage regulator.

Both the rectifier stack and divider are built of four cascaded units, each of which is a complete d-c rectifier, oil immersed and enclosed within an insulating cylinder.

Each unit has two removable windows for replacing the rectifier tubes. The main stack is equipped with polarity reversing switches.

Controls, which will be mounted



New high voltage test set will double capacity of Simplex Wire and Cable Co. testing facility.

on a central control bench, include several special controls, such as a motor-operating grounding device and a variable rate-of-voltage rise control.

cludes Colorado, Montana, New Mexico, Utah, Wyoming, and certain sections of Idaho, Nebraska, Nevada, South Dakota, and Texas.

New agent for Catalyst Exhaust Purifiers, automotive division of Oxy-Catalyst, Inc. is the Freeman Equipment Co., Miami, Fla.

Two new field sales representative organizations have been appointed by Harco Laboratories, Inc. They are: Paul R. Sturgeon, Inc., Boston, to cover the entire New England area; and the G. W. Moler Co., Erlton, N. J., to handle sales in the states of Maryland, Delaware, Virginia, District of Columbia, eastern Pennsylvania, and southern New Jersey.

Sales Briefs

Federal Pacific Electric Co. is now marketing the Cornell-Dubilier line of power capacitors. Industrial capacitors for both low- and high-voltage systems are available.

Babcock & Wilcox Co. has established a boiler division district sales office in Denver, Colo. The new facility has taken over the steam generating equipment sales and service activities which were relinquished by the Stearns-Roger Mfg. Co. on termination of its sales agency agreement with the division March 1. Robert L. Swinney will head up the new district. The territory to be covered by the new district in-

*Trademark



"Superforms* help me keep lines in service"
... DISTRIBUTION ENGINEER

"To me, the word 'Superformed' means a number of plus values:

"Service continuity to keep our customers satisfied
... low maintenance costs
... in short, greater dependability and savings."

Everywhere, Distribution Engineers ... the men technically responsible for keeping customer lines in service ... acclaim Fanner Superforms.

A-1586A

FANNER

Superformed
with a

"PROTECTIVE TWIST"

ARMOR RODS ...

Protect long-span T&D lines at supports

LINEGUARDS ...

Protect short-span T&D lines at supports

PATCH RODS ...

Repair damaged conductors

TAP ARMOR ...

Protects conductor at tapping points

FANNGRIPS ...

For dead-ending strands and conductors

FANNSPICES ...

Join two ends of conductor wire

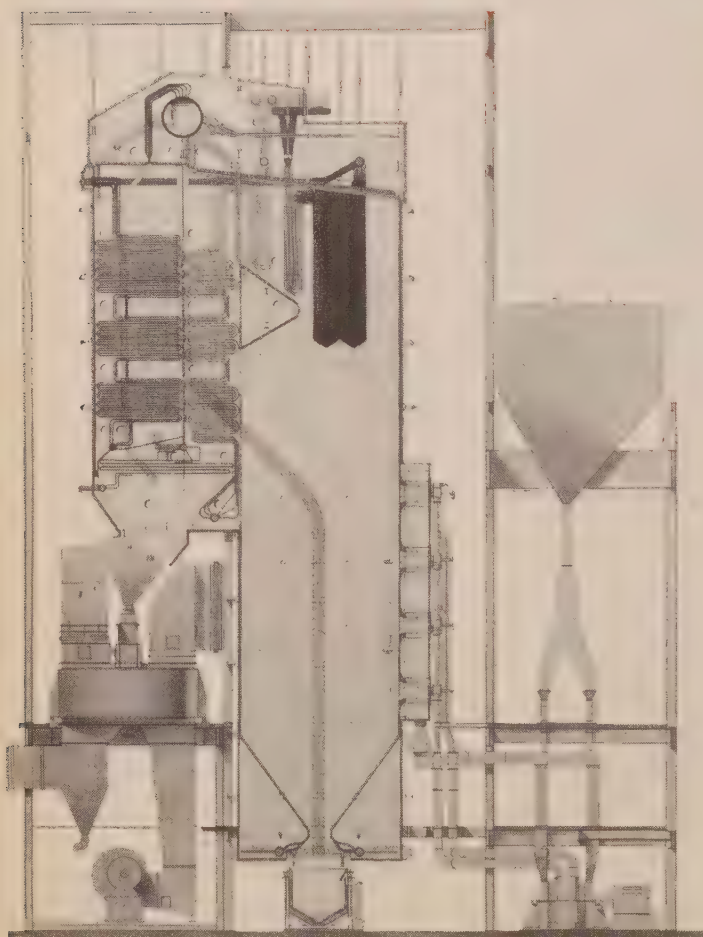
PLASTIC PRODUCTS ...

For conductor surface protection

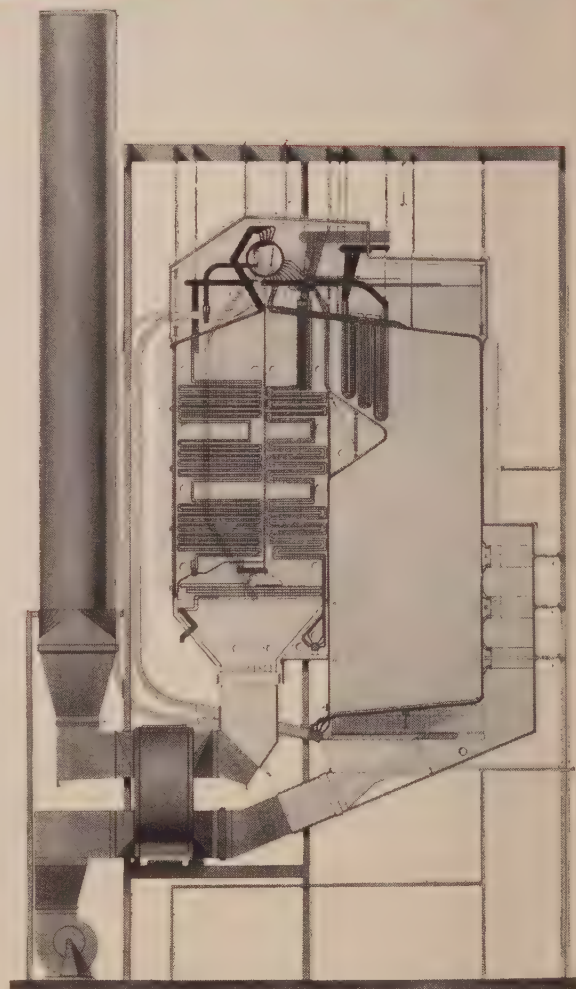
FANNER

The Fanner Manufacturing Co.
Brookside Park—Cleveland 9, Ohio
Division of Textron, Inc.

Are You Planning To Burn **COAL? OIL or GAS?**



950,000 lbs./hr., 1950 psig, 1000/1000F;
Fired By Riley Pulverizers, Flare Type Burners



1,020,000 lbs./hr., 1925 psig, 1005/1005F;
Fired By Gas, Oil — Pressurized Furnace

Riley Custom Boiler Engineering, Know-How In Combustion Can Give You Top Performance Regardless Of The

Riley Boilers Equipped With Complete Riley Fuel Burning Systems

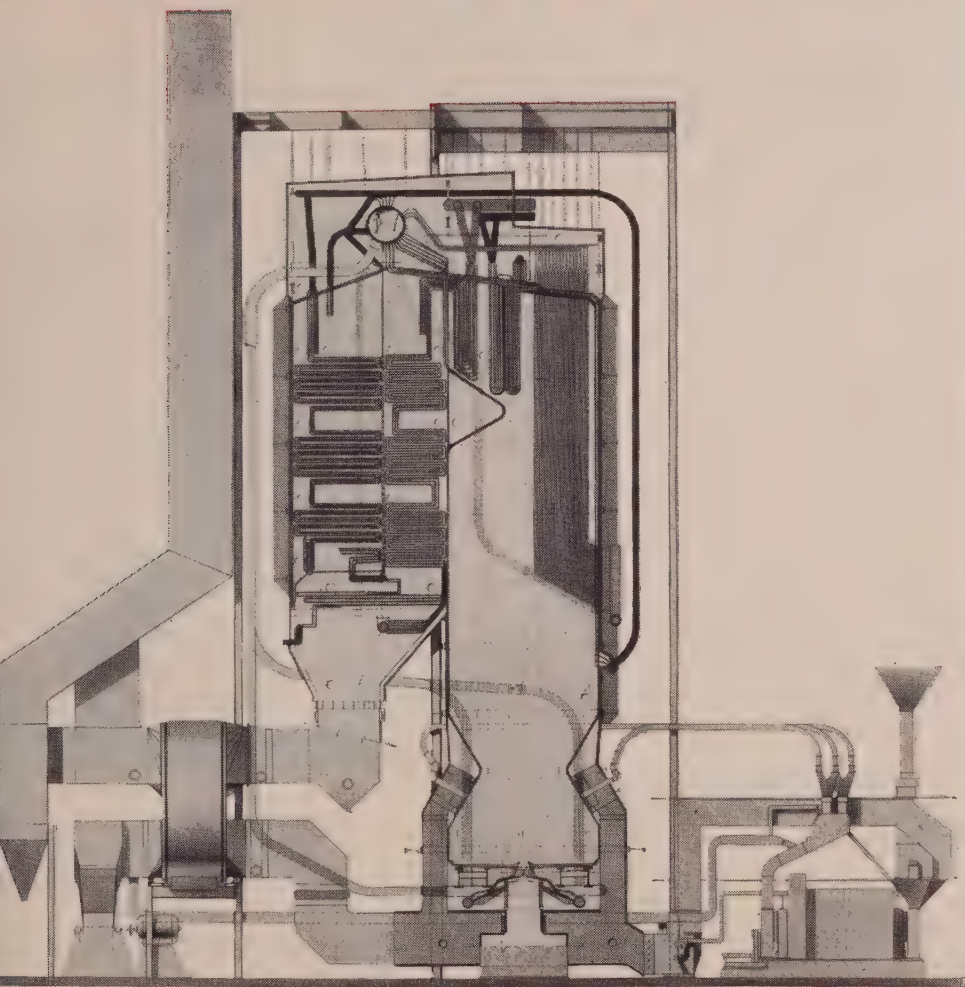
For pulverizing coal Riley offers two types of mills: the Riley Pulverizer and the Riley Ball Mill. These are used with either horizontal Riley Flare Type Gas/Oil/ Coal Burners, or with Riley multiple fuel Directional Flame Burners in Turbo Furnaces. A Riley Boiler installation complete with Riley fuel burning equipment assures Riley's undivided responsibility.

Turbo Furnace Boilers Designed Especially For Multiple Fuels

The Riley Turbo Furnace is ideally suited to firing multiple fuels. When firing coal furnace remains slag-free, flyash disposal is eliminated, carbon loss is negligible. Flame characteristics of gas, oil and coal are similar, simplifying steam temperature control. Available with reheat, non-reheat, with pressurized and non-pressurized furnaces in all capacities and pressures.

A Survey Of Your Plant by A Qualified Consulting Engineer Can Show You Ways To Ma

ALL THREE ?



SOME PUBLIC UTILITIES USING RILEY EQUIPMENT

Louisiana Power & Light Co. (3)
Texas Electric Service Co. (3)
Houston Lighting & Power Co. (13)
Dallas Power & Light Co. (3)
Kansas Gas & Electric Co.
Public Service Co. of Indiana, Inc. (12)
New Orleans Public Service, Inc. (3)
The Holyoke Water Power Co.
Columbus & Southern Ohio Elec. Co.
Central Illinois Light Co. (8)
Hartford Electric Light Co.
Central Power & Light Co.
Monongahela Power Company
Arkansas Power & Light Co.
Southwestern Gas & Electric Co.
Utah Power & Light Co. (3)
Florida Power Corporation (2)
Delaware Power & Light Co.
Minnesota Power & Light Co. (2)
Pacific Gas & Electric Co.
Iowa Public Service Co.
Commonwealth Edison Co.
Manila Electric Co.
Southern Nevada Power Co.
Interstate Power Co. (7)
Northern States Power Co.
Central Louisiana Elec. Co. (2)
Union Electric Co. of Ill. (2)
Northern Virginia Power Co.
Union Electric Co. of Mo. (7)
Pennsylvania Electric Co.
Iowa Electric Light & Power Co. (3)
Iowa-Illinois Gas & Electric Co. (7)
Montana-Dakota Utilities Co.
Mississippi Power Company
Philadelphia Electric Co. (4)
Central Ohio Light & Power Co. (6)
Gulf Power Co. (4)
Otter Tail Power Co. (5)
Public Service Elec. & Gas (N.J.) (7)
So. Carolina Elec. & Gas Co. (3)
Taiwan Power Company (2)

Numbers Indicate Repeat Orders

1,600,000 lbs./hr., 2125 psig, 1005/1005F; Turbo Furnace with Riley Ball Mills;
Pressurized Furnace. Fuels — Gas, Oil, Coal

Techniques, Selectivity Of Fuel Burning Equipment Nature of Fuel, Load, and Steam Conditions

Riley Provides Skilled Construction Engineering Services

Riley Stoker Corporation supplies complete construction services. Riley construction crews employ the latest in construction methods and techniques.

Experienced Service Engineers Assist In Maintaining Safe, Efficient Operation Of Your Boiler

Riley Service Engineers are trained for prompt and efficient servicing of all Riley installations. These experienced engineers work closely with your operators.

Riley Stoker Corporation, having successfully met the challenge imposed by the remarkable growth of the public utilities in the past decade is thoroughly prepared to meet the even greater challenges to come.

You'll Find A Riley Office In Each Of These Principle Cities:

Charlotte, Chicago, Cincinnati, Cleveland, Detroit, Houston, Jacksonville, Kansas City, Los Angeles, New Orleans, New York, Philadelphia, Pittsburgh, Portland, Salt Lake City, San Francisco, Seattle, St. Louis, St. Paul, Syracuse, Worcester.

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RILEY

STEAM GENERATING & FUEL BURNING EQUIPMENT

prising Savings In Your Power Costs



Haley's CEDAR POLES and FIR CROSS ARMS

Light in weight and clean. PENTachlorophenol treated in our modern plant for protection against decay, moisture and insect damage.



TWO strategically located yards:
MINNEAPOLIS,
MINNESOTA
FINDLAY, OHIO

R. G. HALEY & CO.
SPITZER BLDG.
TOLEDO 4, OHIO

MEN OF



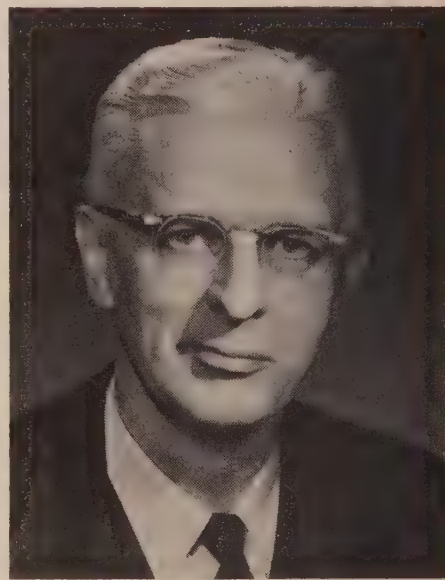
POWER

Linder Nominated For Top AIEE Post

Clarence H. Linder, vice president and group executive, Electric Utility Group, General Electric Co., has been nominated to be the 1960-1961 president of the American Institute of Electrical Engineers. The nomination was announced at the Winter General Meeting of the organization in New York.

Mr. Linder has been a director of the AIEE since 1956 and has been active in a number of the Institute's major areas of interest—including its executive committee, finance committee, planning committee, and committee on relationships with other professional groups. He is a Fellow in the organization.

Others nominated at the meeting include: Robert B. Gear, Commonwealth Edison Co., Charles Hatcher, Consolidated Edison of New York, and Cullen T. Pearce, Westinghouse Electric Corp., to be directors; W. R. Clark, Leeds & Northrup Co., for treasurer; and Clair E. Gaylord, New York Telephone Co., Robert T. Weil, Manhattan College,



Fred W. Bush, Allis Chalmers Mfg. Co., Sim C. Wright, Southwest Bell Telephone Co., Henry A. Carlberg, General Electric Co., Adolph W. Rauth, Consumers Power Co., Walter Criley, Vanderbilt University, and Paul G. Wallace, Texas Power & Light Co., for positions as vice presidents.

Gorman, Vest Named Monongahela V.P.'s

Election of two new vice presidents to the administrative staff of Monongahela Power Company has been announced by Don Potter, president.

G. Ellis Vest will be responsible for coordination of division activities, succeeding Vice President P. H. Sommer, who retired Feb-

ruary 1 after 37 years' service. The other newly-elected vice president, J. Duane Gorman, will be in charge of promotion and sales.

Both Mr. Vest and Mr. Gorman have been with Monongahela since 1937 and for the past several months have been associated with the company's executive staff in its general offices in Fairmont, West Virginia.

Gorman



Vest



Anderson To New Post

Marcus Transformer Co. has announced the election of Bernard H. Anderson as vice-president. He also retains the post of treasurer.

An organizer of the transformer company, Mr. Anderson attended Newark College of Engineering and Rutgers University.

Washington Award to Sedwick

Herbert P. Sedwick has been awarded the 1960 Washington Award of the Western Society of Engineers. The award was announced by Dr. John Rettaliata, president of the organization and president of Illinois Institute of Technology.

The award was made for "leadership and achievement in electric and gas utilities, for true service in education and humanitarian fields



and for developing young engineers."

Mr. Sedwick is the former president of the Public Service Co. Division of Commonwealth Edison Co. He retired in 1958 after nearly 45 years in the Chicago area utility industry.

Although retired from active management of the company, Mr. Sedwick remains a director of the Chicago utility. He is also active in the direction of several educational institutions.

A past president of the Western Society of Engineers, Mr. Sedwick was also cited as "engineer of the year" by the Chicago chapter of the Illinois Society of Professional Engineers in 1958.

ICC Elects Winchell

The Interstate Commerce Commission has elected John H. Winchell chairman of the commission for 1960. He succeeds Kenneth H. Tuggle, 1959 chairman.

The ICC rotates its chairmanship among its 11 members on a seniority basis. Mr. Winchell has been a member of the Commission since

July, 1954. Prior to that, he was chairman of the Colorado Public Utilities Commission.

A new alignment of division assignments was made effective January 1. They are as follows:

Division 1—Commissioners Murphey (chairman), Goff and Herring

Division 2—Commissioners Freas (chairman), MacPherson and Webb

Division 3—Commissioners Arpaia (chairman), Hutchinson and Webb

Division 4—Commissioners Tuggle (chairman), Walrath and Goff

Legislation Committee—Commissioners Winchell (ex officio chairman), Freas and Hutchinson

Rules Committee—Commissioners Winchell (ex officio chairman), Arpaia and MacPherson

Men of Power Briefs

Pennsylvania Power & Light has promoted **Harlan J. West** to the post of special assistant to the vice president-engineering.

Stone & Webster Engineering Corp. has announced the appointment of **John J. Niland** as assistant engineering manager.

A 1959 Laura McCall award for home service achievement has been awarded to **Miss Ethel F. Lord**, home services director for Jersey Central Power & Light Co.

Cleveland Electric Illuminating has named **Donald E. Williams** manager-office building service dept. He is succeeded as secretary and general supervisor of the corporate relations office by **William R. Vogelsang**. **Donald B. Matthews** has become assistant secretary and assistant treasurer.

Marshall G. Hardesty has been elected treasurer of Iowa Electric Light & Power Co. He succeeds **Hugh W. White**, who has retired after 48 years with the company.

Henry B. Roach has been named to replace **Paul Hoheisel** as advertising and public relations manager for Oklahoma Gas and Electric Co. Mr. Hoheisel retired March 1.

Pennsylvania Power & Light Co. has announced the election of vice president **Everett L. Palmer** to the company's board of directors.

NEW KLEIN CATALOG



Here is the 1960 edition of the Klein catalog illustrating and describing the complete line of Klein tools and equipment for electricians.

It contains many new additions to the Klein line—including Replaceable Gaff Climbers, a newly developed Hot Line Grip and an even wider range of pliers for every purpose.

The Klein Catalog 103 will be of interest to linemen, electricians—good workmen everywhere.

Write for yours.

Foreign Distributor: International Standard Electric Corp., New York.

Mathias KLEIN & Sons
Established 1837
7200 McCORMICK ROAD • CHICAGO 45, ILLINOIS

Donald C. Cook, H. A. Kammer, and **Harold Turner**, all executive vice presidents, have been elected to the board of the American Electric Power Co.

New manager of production for Eastern Shore Public Service is **Robert M. Mullin**. He fills the vacancy left by the retirement of **Henry W. Sterling**.

R. A. Larsen has been appointed chief design engineer of Stone & Webster Engineering Corp.

Thomas Works, Delta Star Electric Division, H. K. Porter Co. has a new manager. **James F. Zboyovsky**, who heads up the high voltage electrical porcelain manufacturer, took over last month.

Walter A. Schulz, a 33-year veteran of Public Service Co. of Indiana, has been named chief electrical engineer. He was formerly supervisor of general engineering. Also receiving promotions at the Indiana utility were: **W. O. Montgomery**, system planning manager; **L. A. Crews**, general construction superintendent; **H. L. Hess**, planning engineer; and **R. H. Johnson**, construction superintendent.

Recent appointments at Tampa Electric Co. include: **W. J. Campbell**, administrative assistant to the vice president-finance; **G. P. Wood, Jr.**, assistant to the vice president-sales; **V. S. Price**, advertising and publicity manager; **J. E. Sheridan**, director of employee relations; and **Jack Davis**, director of safety and claims. This is a correction of an announcement which was printed previously.

Two promotions have been announced by the United Illuminating Co.; **Floyd W. Buck** has been appointed engineering manager and **Eugene W. Somerville** named general superintendent.

As part of the executive rotation policy, Commonwealth Edison Co. has announced two changes in assignment. **Murray Joslin**, vice president in charge of production, construction, and engineering, and **Thomas G. Ayers**, vice president of division operations and commercial activities, will exchange their assignments. Mr. Joslin will continue to be in charge of nuclear power activities and Mr. Ayers will remain in charge of the company's industrial relations.

Also at Commonwealth Edison, **Hubert H. Nexon** has been appointed an assistant vice president.

New purchasing agent for Pacific Coast Engineering Co. is **L. L. Compiano**.

Gale M. Hallett has been promoted to the post of sales manager of the Charleston Rubber Co. He will continue as advertising director as well.

The National Insulation Manufacturers Association has announced the election of **Hugh T. Williams**, manager of engineering and industrial sales, Owens-Corning Fiberglass Corp., as vice president of the association.

C. C. Martin, a vice president at S&C Electric Co., has been elected to the company's board of directors.

J. Albert Bertolacci has been promoted to the post of Treasurer of Cornell-Dubilier Electric Corp.

Appointment of **Harold Freese** as general manager of Hi Products, Inc., has been announced by Burton Field, president of General Magnetics, Inc., the parent company.

Robert Tuttle, formerly marketing manager of the H. M. Harper

HOW YOU MAY CUT YOUR MACHINE FAILURES BY AS MUCH AS 25%

by J. R. RATCHFORD, Specialist, Lightning Arresters and Cutout Marketing



Experience shows that 25% of failures of unprotected rotating machinery are due to lightning.

With percentages like that against you, lightning and surge protection is imperative. The cost of this protection is a small fraction of the

a-c motor or generator investment, and can be as low as 1/100th the cost of only one large a-c machinery repair. General Electric lightning protective equipment is available for all ratings of a-c machine operating voltages.

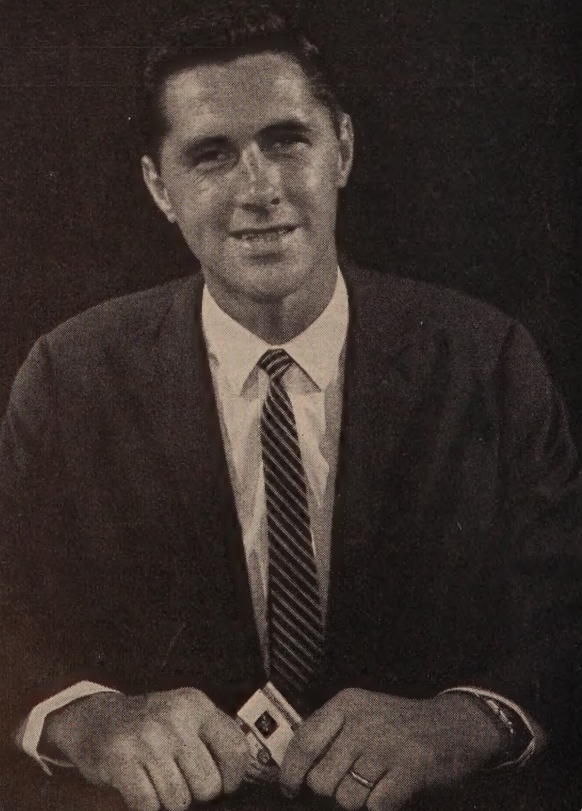
The **Pyranol*** protective capacitors in the G-E system provide turn-to-turn insulation protection by reducing the steepness of applied lightning surges and reflections within multi-turn machine windings. The **Thyrite*** Magne-valve station-class arresters protect the major (line to ground) insulation by limiting the magnitude of incident and reflected surges on the windings. Used in parallel, this combination effectively combats lightning-caused machine downtime and resulting repair costs.

May we show you specifically how you can protect your a-c rotating machinery? Contact your General Electric representative for full details or write to Sect. 435-24, General Electric Co., Schenectady 5, N. Y.

* Registered Trademark of the General Electric Company.

GENERAL  ELECTRIC

General Electric Capacitor-



Co., has been promoted to the position of assistant to sales vice president. He is succeeded by Robert M. Hausheer.

The Worthington Corp. has announced that the board of directors has elected **A. William Fraser** vice president and general sales manager. The firm has also elected **V. C. Cheek**, **H. W. King**, and **W. J. Van Vleck** commercial vice presidents.

Chester F. Mitchell has been appointed engineering consultant to the RT&E Corp. He retired recently from Commonwealth Edison Co.

Allan Schultz has joined the power systems engineering staff of **I. Zinder & Associates**. He was formerly with the Electric Utility Engineering Section of G-E.

Allis-Chalmers has appointed **Paul E. Dimberg** manager of utility sales and **Hugh C. Blair** manager of industrial sales in the New Orleans district.

Baxter L. Schroeder has been named Western regional sales manager of the utility division of Highway Trailer Co.

Federal Pacific Electric has appointed **Lewis H. Walke** director of utility sales.

R. B. Ames has been named manager-marketing at G-E's medium transformer department.

Darnell To Head Constructors



Donald W. Darnell has been elected president of the National Constructors Association. Chairman of the board of the Fluor Corp., Mr. Darnell will serve during 1960. NCA is an organization of major engineering and building firms engaged in the design and construction of power plants, chemical and petroleum plants, steel mills and other industrial facilities.

A. Russell Young has been appointed assistant executive vice president and general manager of **J. F. Pritchard and Co.**

The Gold Medal of the Newcomen Society in North America has been awarded to **Clarence B. Campbell**, chief engineer of the Westinghouse steam division.

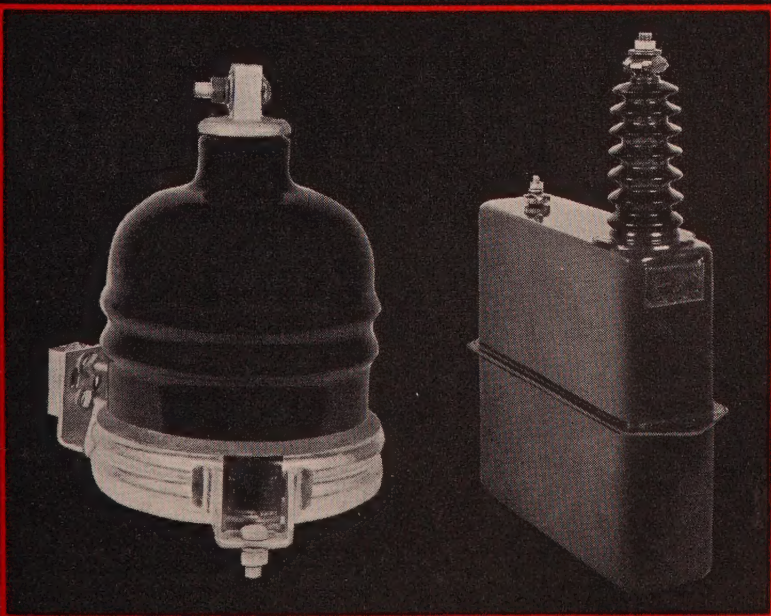
ELECTRICAL ENGINEER

Strong Midwest manufacturer located near a fine cultural and educational center wants experienced individual for headquarters sales staff. Previous sales, administrative or design experience required. Electric utility background helpful. Company offers good salary, advancement incentive, full benefits and excellent working conditions. Send complete resume in confidence. Address Box 3153, **ELECTRIC LIGHT & POWER**, 6 No. Michigan Ave., Chicago 2, Illinois.

HELP WANTED

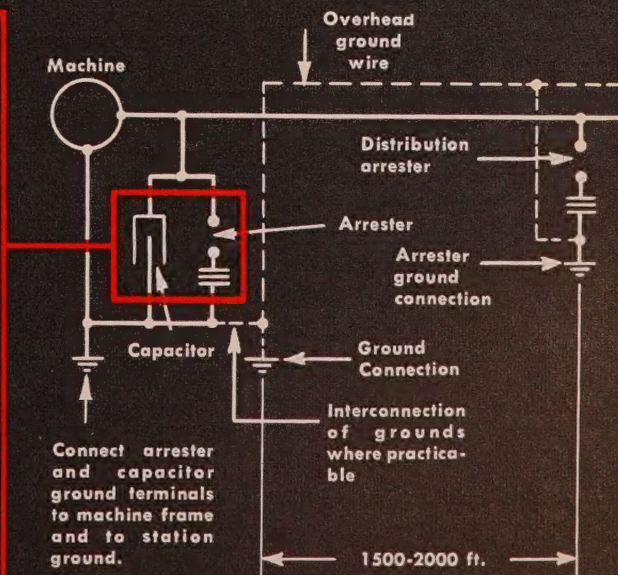
GRADUATE ELECTRICAL ENGINEER — Electric Utility in Eastern Massachusetts. Some experience in transmission and distribution desired. Please answer, giving education, experience and salary expected. Write Box 3153, **ELECTRIC LIGHT & POWER**, 6 No. Michigan Ave., Chicago 2, Ill.

Arrester Combination Gives You Low-Cost Lightning and Surge Protection for Your High Investment in A-C Rotating Machines



Thyrite Magne-valve station-class arrester

Pyranol filled capacitor



Typical scheme of protection for machines connected directly to exposed overhead lines

CALENDAR OF EVENTS

- March 21-23—Southeastern Electric Exchange, Annual Conference, Boca Raton Hotel, Boca Raton, Fla.
- March 21-23—National Electrical Manufacturers Association, First National Electric House Heating Exposition, Hotel Sherman, Chicago, Ill.
- March 24-25—Oklahoma Utilities Association, Annual Convention, Oklahoma Biltmore Hotel, Oklahoma City, Okla.
- March 27-29—Southwest Electric Conference, Chandler, Ariz.
- March 28-29—Pacific Coast Electric Association, Engineering and Operation Conference, San Francisco, Cal.
- March 29-31—22nd Annual American Power Conference, Hotel Sherman, Chicago, Ill.
- April 3-8—Engineers Joint Council, Nuclear Congress, Coliseum, New York, N. Y.
- April 4-6—Edison Electric Institute, 26th Annual Sales Conference, Edgewater Beach Hotel, Chicago, Ill.
- April 7-8—Southeastern Electric Exchange, Engineering and Operation Section Conference, Roosevelt Hotel, New Orleans, La.
- April 11-13—A. and M. College of Texas, Thirteenth Annual Conference for Protective Relay Engineers, College Station, Tex.
- April 20-22—Missouri Valley Electric Association, Engineering Conference, President Hotel, Kansas City, Mo.
- April 27-29—Northwest Electric Light and Power Association, Engineering Conference, Hotel Florence, Missoula, Mont.
- April 28-29—Pennsylvania Electric Association, Systems Operation Committee, Bedford Springs Hotel, Bedford, Pa.
- May 2-4—Edison Electric Institute, Purchasing and Stores Committee, Annual Meeting, The Warwick, Philadelphia, Pa.
- May 12-13—Public Utilities Advertising Association, Annual Convention, Waldorf Astoria Hotel, New York, N. Y.
- May 16-18—Pacific Coast Electrical Association, Annual Convention, Stardust Hotel, Las Vegas, Nev.
- May 23-25—Northwest Electric Light and Power Association, Business Development Conference, Chinook Hotel, Yakima, Wash.

INDEX TO ADVERTISERS AND THEIR AGENCIES

Allis-Chalmers Mfg. Co.	39, 98, 99	KPF Electric Co.	30
Klau-Van Pietersom-Dunlap, Inc.		L. C. Cole Co., Inc.	
Anaconda Wire & Cable Co.	44, 45	Kearney Corp., James R.	46
Kenyon & Eckhardt, Inc.		Lynch & Hart Advg. Co.	
Anderson Electric Corp.	Inside Front Cover	Klein & Sons, Mathias	121
Tucker Wayne & Co.		The Buchen Co.	
Baltimore & Ohio Railroad,		Kuhlman Electric Co.	42
Freight Dept.	108	Fred M. Randall Co.	
The Richard A. Foley Advg. Agency, Inc.		Lapp Insulator Co., Inc.	90, 91
Bartlett Tree Expert Co.	38	Wolff Associates, Inc.	
Bruce Angus Advg., Inc.		Line Material Industries,	
Bethea Co., Inc.	26	McGraw-Edison Co.	11
Crim-Thomas Agency		Erwin Wasey, Ruthrauff & Ryan, Inc.	
Blackburn Corp., Jasper	36	Moloney Electric Co.	Outside Back Cover
Ridgway-Hirsch Advg. Co.		Hebert-Robinson, Inc.	
Brown Boveri Corp.	12	Motorola Communications & Electronics,	
Max Berking, Inc.		Inc.	27
Central Transformer Corp.	20, 21	Kolb & Abraham, Inc.	
Brooks-Pollard Co.		Ohio Brass Co.	54
Chance Co., A. B.	93, 94	Howard Swink Advg. Agency, Inc.	
Arthur R. Mogge, Inc.		Pennsylvania Transformer Div.,	
Coffing Hoist Div.,		McGraw-Edison Co.	64, 65
Duff-Norton Co.	110	Ruben Advg. Agency	
Bond & Starr, Inc.		Pfaff & Kendall	112
Combustion Engineering, Inc.	50, 51	Richard-Lewis Corp.	
G. M. Basford Co.		Portable Light Co., Inc.	101
Copperweld Steel Co.	31	Frederick S. Oliver Advg.	
Reuter & Bragdon, Inc.		Preformed Line Products Co.	40, 41
duPonts de Nemours & Co., (Inc.), E. I.,		The Bayless-Kerr Co.	
Elastomer Chemicals Dept.	28, 29	Reynolds Metals Co.	107
Batten, Barton, Durstine & Osborn, Inc.		Clinton E. Frank, Inc.	
Eisler Transformer Co., Inc.	109	Riley Stoker Corp.	116, 117
Walter J. Zimmerman Associates		Seth R. Martin Advg.	
Electro-Motive Div.,		Roebbling's Sons Corp., John A.	6
General Motors Corp.	15, 16, 17	Hazard Advg. Co., Inc.	
Marsteller, Rickard, Gebhardt & Reed, Inc.		Rome Cable Div.,	
Erico Products, Inc.	Inside Back Cover	Aluminum Co. of America	34, 35
Allan H. Siebert Advg.		The Rumrill Co., Inc.	
Fanner Mfg. Co.	115	Sangamo Electric Co.	52, 53
Palm & Patterson, Inc.		Arthur R. Mogge, Inc.	
Fargo Mfg. Co., Inc.	13	Sargent & Lundy	59
Lescarbours Advg., Inc.		Armstrong Advg. Agency, Inc.	
Fisher-Pierce Co.	104	Sherman & Reilly, Inc.	114
Culver Advg., Inc.		Power & Condon Advg.	
General Electric Co.,		Sikorsky Aircraft Div.,	
Cleveland	47	United Aircraft Corp.	55, 56
Batten, Barton, Durstine & Osborn, Inc.		Campbell-Ewald Co.	
General Electric Co.,		Southern States Equipment Co.	22, 23
Schenectady	43, 85, 86, 87, 102,	Lowe & Stevens Advg.	
103, 122, 123		Southwire Co.	37
G. M. Basford Co.		Lowe & Stevens Advg.	
Haley & Co., R. G.	118	Subox, Inc.	95
Holan Corp.	19	The Shivel-Hall Co.	
The Bayless-Kerr Co.		Wagner Electric Corp.	24, 25
Hotpoint Co.	14	Arthur R. Mogge, Inc.	
Compton Advg., Inc.		Westinghouse Electric Corp.,	
I-T-E Circuit Breaker Co.,		Pittsburgh	32, 33, 48, 49
Switchgear Div.	18	Fuller & Smith & Ross, Inc.	
Gray & Rogers Advg.		Wyoming Valley Equipment Div.,	
Indiana Steel & Wire Co., Inc.	113	Sterling Engrg. & Mfg. Co.	108
Bob Robinson, Inc.		Robert T. Krause, Advg.	
Island Creek Coal Sales Co.	60		
Stockton, West, Burkhardt, Inc.			